Xerxes the successor of Darius, in his previously mentioned campaign against the Greeks, also had occasion to pass the same sea, but at another point.* While he was preparing to go to Abydos, numbers were employed in throwing a bridge over the Hellespont from Asia to Europe. The coast toward the sea from Abydos, between Sestos and Madytus in the Chersonese of the Hellespont, is described as rough and woody: the distance from Abydos being seven stades, or nearly a mile. The work however commenced at the side next Abydos. The Phœnicians used a cordage made of linen, the Egyptians the bark of the biblos. The bridge was no sooner completed than a great storm arose which destroyed the whole work, which when Xerxes heard, he ordered, as is well known, the Hellespont to be flogged, and a pair of fetters to be thrown into it. The engineers got worse off, for they were sentenced by the king to be beheaded. Our historian goes on to say with some naïveté that a bridge was then constructed by a different set of engineers—which we should naturally imagine, for it is difficult to conceive how men who were beheaded, could very easily preside at works *à la Saint Denis*. The mode employed, as far as it can be made out, was to connect together ships of different kinds, some long vessels of fifty oars, others three banked gallies. These were arranged in a double row, one set transversely, but the other in the direction of the current. When these vessels were firmly connected to each other, they were secured on each side by anchors of great length; they left however openings in three places, sufficient to afford a passage for light vessels, which might have occasion to sail into the Euxine or from it. Having performed this, they extended cables from the shore, stretching them upon large capstans of wood, for which purpose they did not employ a number of separate cables, but united two of white flax with four of biblos. These were alike in thickness, and apparently so in goodness, but those of flax were in proportion much the more solid, weighing not less than a talent to a cubit, an expression showing that the ancients knew how to appreciate the qualities of cordage. When the pass was thus secured, they sawed out rafters of wood, making their length equal to the space required for the bridge; these they laid in order across upon the extended cables, and then bound them fast together. They next brought unwrought wood, (fascines qy.) which they placed very regularly upon the rafters: over all they threw earth, and which they raised to a proper height, and finished all by a fence on each side, that the horses and other beasts of burden might not be terrified by looking down upon the sea. Two ways were thus made, one on each set of boats; on one of these ways, namely, the northern, the infantry and cavalry passed, and over the southern the camp followers and the baggage. The bridge was afterwards destroyed by a storm.

At a subsequent period of the campaign Xerxes contemplating flight, for the purpose of amusing the Athenians, he made an effort to connect the island of Salamis with the continent, joining for this purpose the Phœnician transports together to serve both as a bridge and a wall.

BRIDGE.—EUPHRATES—BRICKS.

Babylon,† being divided by the river Euphrates into two distinct parts, whoever wanted to go from one side to the other was obliged to pass the water in a boat. To remedy this general inconvenience, and mentioned by the historian as an expedient not usual, Nitocris, Queen of Babylon, determined upon building a bridge, from which period we may date the formation of permanent bridges as a part of engineering. Having procured a number of large stones, she changed the course of the river, directing it into a canal prepared for its reception, and so into a large marsh or reservoir. The natural bed of the river being thus made dry, the embankments on each side near the centre of the city were lined with bricks, hardened with fire. Upon this we may remark that the Babylonians used two kinds of bricks, the common brick, baked in the sun, and another brick burnt in a furnace; this latter kind was most probably used on this occasion, as the more durable. Nitocris, then with the stones before prepared erected a number of piers, strongly compacted with iron and lead; on these piers a platform was laid, which was removed at night to prevent communication between the different quarters of the city. The bridge being completed, the river was allowed to return to its natural bed. This work, according to Diodorus Siculus, was five furlongs in length.

EMBANKMENTS.—EUPHRATES—ACES—SLUICES.

Nitocris, just mentioned, is said to have been the author of several other remarkable works, some of which are however, doubtful. Being fearful of the ambition of the Medes, she is said, for the purpose of preventing communication with them by the Euphrates, to have diverted the course of the river above Babylon, by sinking a number of canals, and giving it a winding shape. To restrain the river on each side, she raised banks, which are described as wonderful on account of their enormous height and substance. A large lake or reservoir is also attributed to this queen, its circumference being stated at fifty miles, but it is more than probable that her works were confined to reclaiming part of a natural marsh, or to securing the banks; these she lined with stones brought thither for that purpose.

Herodotus relates in his third book an account of operations on the river Aces, on which doubt has been thrown, but which whether true or false, will be equally interesting as illustrating the engineering opinions of the ancients. He says that there is in Asia a large plain surrounded on every part by a ridge of hills, through which there are five different apertures. It formerly belonged to the Chorasmians, who inhabit those hills in common with the Hyrcanians, Parthians, Sarangensians, and Thomaneans; but after the subjection of these nations to Persia, it became the property of the great king. From these surrounding hills there issues a large river called Aces: this formerly, being conducted through the openings of the mountain, watered the several countries before mentioned. But when these regions came under the power of the Persians, the apertures were closed, and gates placed at each of them, to prevent the passage of the river, from which expression we infer that the Persians were acquainted with the use of sluices. Thus on the inner side, from the waters having no issue the plain became a sea, and the neighbouring nations, deprived of their accustomed resource, were reduced to extreme distress from the want of water. In winter they, in common with other nations, had the benefit of the rains, but in summer, after sowing their millet and sesame, they required water, but in vain. Not being assisted in their distress, the inhabitants of both sexes hastened to Persia, and presented themselves before the palaces of the king, made loud complaints. In consequence of this, the monarch directed the gates to be opened towards those parts where water was most immediately wanted, ordering them again to be closed after the lands had been sufficiently refreshed; the same was done with respect to them all, beginning where moisture was wanted the most. This, however, was only granted in consideration of a large donation over and above the usual tribute.

That the Persians were well acquainted with the operation of damming appears also by other instances. Xerxes having examined the Peneus, a river of Thessaly, inquired whether it could be conducted to the sea by any other channel, and received from his guides, who were well acquainted with the country, this reply; "As Thessaly, O King, is on every side encircled by mountains, the Peneus can have no other communication with the sea." "The Thessalians," Xerxes is said to have answered, "are a sagacious people. They have been careful to decline a contest for many reasons, and particularly as they must have discerned that their country would afford an easy conquest to an invader. All that would be necessary to deluge the whole of Thessaly, except the mountainous parts, would be to stop up the mouth of the river, and thus throw back its waters upon the country."

(To be continued.)

* Herodotus, Polymnia.
† Herodotus, Clio.

A SUBSTITUTE FOR CHIMNEY-POTS.

Sir—Owing to the many accidents which have occurred through the late storm, from the falling of those ugly and useless appendages (called chimney pots), which disgrace the noble works of architecture in our metropolis, I am induced to trouble you with a few lines, should you consider them worthy of insertion in your valuable publication. It has frequently been a subject of my thoughts, how chimney pots were first introduced, as they certainly are most useless and unsightly articles.

Perhaps, if I draw the attention of your readers to the form of a tin horn, such as is used by guards of mail coaches, the principle of chimneys will be better and more easily understood; if builders will only try the experiment, I feel satisfied they will no longer continue one of the greatest imperfections of our common system and mode of building. If the large end of the horn be placed downward over some ignited bituminous matter, we shall find only part of the smoke will ascend; but if we place the small end down, we shall not only find the draft greatly increased, but the smoke will ascend freely up the tube.

Hoping these observations will be of service to the public,

I remain, Sir,
Your obedient servant,
J. R. B., C.E.

Brixton Road,
January, 1841.

REMARKS ON THE MORTAR USED IN ANCIENT BUILDINGS.

WITH OBSERVATIONS AND DIRECTIONS FOR PREPARING MORTAR IN A MORE PERFECT MANNER THAN THAT NOW IN PRACTICE.

THE great perfection to which the arts have attained cannot be denied; yet on examining the monuments of former ages, of which many are still to be seen in this country, it does appear that the ancients had some manner of making and using mortar for their buildings, of which our modern artists seem either to be ignorant, or do not choose to put in practice. Although the grand edifices raised under the direction of the artists of the present age, is a proof that our modern masters, by the study of the monuments left us by the ancients, have been enabled to construct buildings vying with their patterns; yet the moderns are still behind the ancients in the construction of buildings with small or promiscuous materials, with that degree of solidity which seems almost to set time itself at defiance.

There is no doubt little difficulty in raising lasting edifices by building immense blocks of solid stone, one upon another—but if we say nothing of the enormous expense of this mode of construction, even where the materials are to be found in the vicinity, there is some consideration necessary when works which require durability are to be constructed, where no large materials can be readily found. Hence the erection of buildings which may be of the utmost importance in a national point of view, as well as to individuals, has to be abandoned, on account of the enormous expense attending the modern plan of construction.

On a careful examination of many of the old castles in this country, it will be seen that the materials which have been used are of the most ordinary kind; and from the manner in which they have stood for such a long period of time, it does most readily occur, that the mortar used in these buildings, has been prepared in a different manner from that practised by modern builders. In fact it will be found that many of these old buildings have been put together with almost every description of stones down to the smallest pebble collected from the bed of the brook, and where no heavy carriages or complicated machinery have been required to construct the most extensive works.

Our ancient bridges and aqueducts all exhibit specimens of the same kind of construction with very small stones; depending therefore on the superior manner of preparing the mortar by which these small materials have been cemented together.

Thus there seems to be an art lost, and in place of endeavouring to recover this art by a series of well conducted experiments, men of genius, and particularly our modern philosophers, seem to have principally in view to bestow their labours in pushing into the world books filled with abstract calculations which they understand only on paper. These calculations are, however, by far too nice, and it is much to be feared that few of the writers could be found to reduce them to practice—and as practical men do not understand them, they are useless to the world. It may be very well for the physician to write a learned prescription intermixed with hieroglyphics, to the apothecary who understands it; but alas! the carpenter and builder have neither time nor inclination to enter into the abstruse analysis of the philosopher. Bred to labour from their early youth, it is only from experience they are accustomed to learn; and it is therefore only from a course of well regulated experiments, described in plain language and simple figures, that the labouring artist's attention can be arrested.

It would therefore in almost all cases be the means of more rapidly diffusing a knowledge of the useful arts, were our seminaries furnished with the means of exhibiting in some degree of experiment, specimens of the various useful arts. For without experience what is the young engineer who is sent forth to direct the operations of a siege, to raise fortifications, form aqueducts, or construct bridges? It is clear he has yet to learn from the labouring artificer, the essential parts of his business; and thus he is sent forth only with the name, to learn from those of inferior station, who are here found capable of giving instructions from experience, where fine theories and abstruse analysis can be of little avail.

To return, however, to our ancient buildings, where it appears neither time nor labour was lost in the execution. Many of them seem constructed of little else than rubbish thrown together with an outer coating of small stones, or pebbles from the brook, but built with a kind of mortar which appears to have been thin enough to penetrate the smallest crevices, and to form a solid, compact, nay almost an impenetrable body. And if the ruins are considered with the smallest degree of attention, it will convince us that all the secret of this mode of construction, consists in the preparing and using the mortar which has bid defiance to time, and to the tools of the quarrier to remove, after the lapse of ages. Every workman who has been engaged in taking down any of our old castles, will testify that he has always been able to remove the stone with greater facility than he could disengage the mortar.

How differently then must this mortar have been prepared from the very best which is now prepared by our modern builders; for the latter only dries to fall to dust again when broken into. Another of the grand qualities of the ancient mortar is its being impenetrable to water; and, in fact, the aqueducts for retaining and conveying water which are still to be seen, exhibit no marks of clay or other kind of puddle having been used for retaining the water. Therefore, it does appear that aquatic as well as other works, were frequently constructed of very small stones, by the builders of former ages, and that they were in the practice of forming parts of their buildings into cases or *caissons* of planking, by which means the mortar when run in amongst the interstices of the small stones, was prevented from escaping.

It can therefore be most readily conceived how easily a building of great magnitude may be constructed at a small expense, and that of the most durable and lasting kind, of materials with which almost every part of our country abounds, if we are only careful in the preparation of the mortar with which these materials are to be cemented together.

It does not appear that the ancients used any other ingredients in their mortar than lime, sand, or calcined earth, such as brick dust, when proper sand could not be procured; and therefore, as already mentioned, the whole secret seems to be the manner of preparation, of which some explanation will now be attempted.

It is presumed the fact is well known, that in the burning of limestone, the fixed air which it contains escapes, and the stone by this means loses its weight. It has indeed long been the practice to grind or slack the lime immediately after being burned, and by means of mortar mills (where the extent of the works can afford them) to prepare the hot mortar for immediate use for building or bedding large materials; but, it is a fact well known that this kind of mortar (to say nothing of the great expense of procuring it), would be useless in ordinary buildings, as the weight of the substance in thin walls composed of small materials, would not prevent the burstings, cracks, and sets, which would take place; nor, from the consequence of blistering which always happens when mortar prepared in this way, is used; rendering it unfit for plastering either to withstand the action of the weather, or for lining water courses; because it suddenly dries by the evaporation of its moisture, and consequently, immediately gives way to cracks and shrinking.

On the other hand lime-mortar after lying a considerable time in a sowered state, imbibes again the fixed air which was discharged in the process of burning, and when carefully examined in this state, presents a kind of transparent, or rather icicle, appearance, which destroys in a great measure the binding quality, and which, in our changeable climate, rarely or ever has the effect of cementing the building. The latter, however, is the manner in which almost all the lime mortar is most commonly prepared for building, both from a regard to economy as requiring less lime, and also with regard to labour; and, it is more than probable it was by hand labour also, that the builders of former ages prepared their mortar. It is therefore to this principle that observations have been directed, of which the following notice is submitted, and which it is hoped, if properly attended to, will enable those who wish to do so, to prepare and use lime-mortar not inferior to that of the ancients.

Sower together a quantity of lime and clean sharp sand for two or three weeks before being used; work this well and turn it aside, and as the proportion of the lime to the sand, will always depend on the quality of the former, all that is necessary is, to take care (in sowering), if the lime is of a rich quality, to put one-third less lime into the heap, than it is intended to be built with; and, if the lime is of poor quality, say only one-fourth less. (It may here be observed that in general lime of the poorer quality is best for cementing building.) When the lime which has been previously sowered, as before directed, is to be used in the building, or otherwise, it is to be again worked carefully over, and one-fourth of quick lime added in proportions, taking care never to have more in preparation than can be used in a short time; and this quick lime should be most completely beaten and incorporated with the sowered lime, and it will be found to have the effect of causing the old lime to set and bind in the most complete manner. It will become perfectly solid without the least evaporation to occasion cracks, which can only ensue in consequence of evaporation; and this can only happen from the want of proper union between the two bodies. But by mixing and beating the quick lime with the sowered mortar, immediately before it is applied to use, the component parts are brought so near to each other, that it is impossible either crack or flaw can take place. In short beating has the effect of closing the interstices of the sand, and a small quantity of lime paste is effec-

tual in fitting and holding the grains together, so as to form a plastic mass by uniting the grains of sand which otherwise would not fit each other. This system will apply to lime-mortar for all descriptions of work, whether for building, plastering in the inside or outside of houses, water cisterns, ground vaults, rough casting, &c. &c.

It may not be improper to mention that whenever there is any difficulty in procuring proper sand for building, clay is an excellent substitute; and all that is necessary is, to make it into balls, and burn it, and then pound it like brick-dust, or pozzolano earth. There is no doubt, in addition to the superior scheme of making mortar in former ages, that, when they used only the small stone, which we see in the ruins of their buildings, they were in the practice of using temporary casings of boarding which they could move from place to place as the building advanced, and which would enable them to grout or fill up with their quick mortar all the interstices in the successive layers of stones. And moreover, by having the boarding of their centering for arches and conduits quite close, they were enabled to lay on, along with their stone, almost an impenetrable coating of plaster.

From the foregoing observations, it is hoped, it will be most clearly seen that an easy mode of erecting substantial and durable building is generally within our reach, and that the most inferior kind of stones may be used, providing proper care is taken in the preparation of the lime-mortar with which they are to be cemented together.

John Gibb,
Aberdeen, January 2, 1841. M. Inst. C. E.

ON THE CONSTANCY OF CALORIFIC ABSORPTION,

EXERCISED BY THE BLACK OF SMOKE AND BY METALS; AND ON THE EXISTENCE OF A DIFFUSIVE POWER, WHICH BY ITS VARIATIONS CHANGES THE VALUE OF THE ABSORBING POWER IN OTHER ATHERMANTIC BODIES.

(Translated from the French of M. Melloni, *for the* C. E. & A. Jour.)

There were great difficulties to be overcome in the attempt to prove that the black of smoke, subjected to the action of different kinds of radiating heat, always absorbs the same proportions of them. The question would be immediately solved if we could successively expose the blackened body to equal radiations, drawn from several sources of caloric; for a thermometer plunged in the interior of the body would show by the greater or less elevation of temperature, whether the quantities of heat absorbed vary or not with the quality of the incident heat. When however we come to use the thermometer or thermoscope in experiments on radiating heat, it becomes necessary, as we shall hereafter see, to cover them with the black of smoke. On the other hand, to compare two forces, whatever the effect which they produce upon the measuring instrument must be estimated exactly in proportion to their intrinsic energy. Thus we cannot compute the relative intensity of rays of heat but by admitting the principle in question: the experiment therefore of a thermometer plunged in the interior of the body would be quite illusory.

The first operation is to take a disc of wood, of which one face is white and the other black; this is fixed vertically upon a stock moveable upon its axis, and having successively brought the two surfaces by a half revolution of the disc in presence of the radiation of a lamp concentrated by a glass lens, each time is collected with a very sensible thermometer provided with a reflector, the secondary calorific radiation projection by the side on which the direct rays fall, after this radiation has traversed a plate of glass interposed between the disc and the thermometer. In the case of the black face there is no sign of heat; but things are different with regard to the white face, from which is obtained a very intense indication of caloric. It is well known that white bodies can never be heated more than black bodies under the influence of any radiation whatever, and under the circumstances of the experiment the black face gives nothing; therefore the great action of the white face does not arise from the absorbed heat, but from a true dispersion, similar to the diffusion suffered by luminary rays and the exterior of opaque bodies. To prove the variable diffusive action which a white surface exercises on calorific rays from different sources, and the constant absorption of the black of smoke in all kinds of heat, a very sensible thermometer is used with a reflector, carefully sheltered from rays direct from the source and by it are measured the true secondary anterior and posterior radiations projected from the surface of an immoveable disc subjected to a given radiation. The same observations are repeated for several kinds of heat by employing two discs of thin cardboard, one painted black and the other covered with a substance more or less white. The first of these discs constantly exhibits the same relation between the rays vibrated by the two faces, the second shows very different relations. Underneath is shown the relative results of four species of rays arranged according to the order of the temperature, of the sources from which they emanate.

Black disc	$\frac{10}{12}$	$\frac{10}{12}$	$\frac{10}{12}$	$\frac{10}{12}$
White disc	$\frac{10}{14}$	$\frac{10}{18}$	$\frac{10}{23}$	$\frac{10}{34}$

In order to enable us to draw conclusions from these figures, it is for the present to remark that the posterior face of each disc radiates in consequence of the heat absorbed while the anterior face acts at the same time by virtue of the radiations caused by absorption and diffusion; we therefore see 1st. That the black of smoke absorbs and disperses all kinds of calorific rays with the same energy. 2nd. That the diffusibility of caloric on the surface of the white disc increases with the temperature of the source.

As a detail of the other experiments would require too great a space, it will be sufficient to sum up here the general results.

1. The superficial layers of bodies cause to radiating heat a dispersion analogous to luminous dispersion.

2. We possess sure means of distinguishing calorific diffusion from the radiation derived from the proper heat of the body, notwithstanding both radiations are equally composed of elementary pencils radiating in every direction around the centre of action.

3. The black of smoke produces very little diffusion equal for all kinds of radiations.

4. That other substances, and especially white bodies are very different, as they strongly disperse rays from incandescence, and weakly disperse those which derive their origin from sources of temperature.

5. This special characteristic is enough to show that we must not attribute the phenomenon of calorific diffusion to every regular or irregular reflection whatever; for this would take place with the same energy for all kinds of heat.

6. The dispersive action of metals is generally speaking more intense than that of white bodies; it especially differs by its invariability, and on this point resembles the feeble diffusion observed in the black of smoke.

7. By comparison between the phenomena of calorific diffusion and those of luminous diffusion, it appears 1st. That the black of smoke is a true black matter, both as regards radiating light and heat. 2nd. That white bodies act with regard to radiating heat as coloured substances with regard to light. 3rd. That metals act upon calorific radiations as white bodies do upon luminous radiations.

8. The diffusion sends back a part of the incident rays proportionate to its intrinsic energy, and thus diminishes the calorific absorption of the whole portion of heat dispersed by the action of the surface.

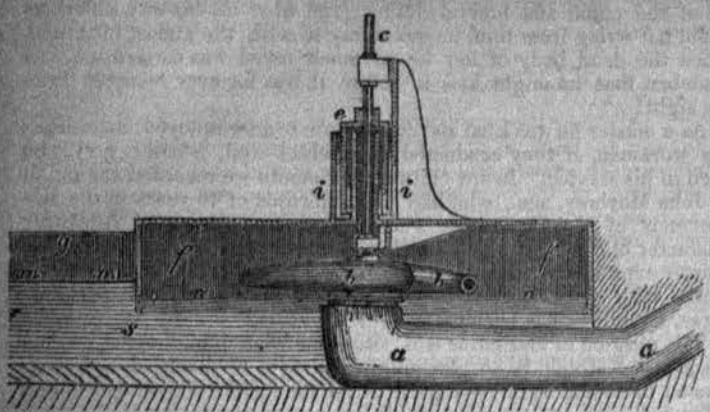
THE PNEUMATIC MARINE PRESERVER.

Sir—In viewing the many interesting and scientific exhibitions at the *Polytechnic Institution* in Regent Street, my attention was more particularly arrested by the model of a ship fitted up with a new invention, called the Pneumatic Marine Preserver; indeed, I was astonished to see the little vessel, though full of water and cargo, still keep afloat, and to a casual observer's eye, without the least aid, as the apparatus occupies so little room, and is so placed out of the way, that ninety-nine out of a hundred would not observe the reason of its buoyancy. While carefully examining the craft, a person who shows it to the public, suddenly exhausted the air, and she gradually sunk completely out of sight; but to my surprise, by a few strokes from the condensing air-pump, she immediately rose to the surface of the water, and again floated about.

Being an old sailor, I thought it a duty I owe to my fellow creatures to make it known to the public through your valuable Journal: and I would particularly advise captains to have their boats fitted up with the Patent Pneumatic Marine Preserver, as, in case of danger, they then become perfect life-boats, far superior to any yet invented for room, lightness, and buoyancy. If ever there was an invention of incalculable service to sea-faring men this is the one, and deserving of their utmost attention if they value life or property.

I remain
London, Your obedient servant,
January, 1841. An Old Sailor.

IMPROVEMENT IN MESSRS. WHITELAW AND STIRRAT'S WATER-WHEEL.



In the "Mechanics' Magazine" we have a suggestion for an improvement in Messrs. Whitelaw and Stirratt's Water Wheel, given in last month's Journal, of which the accompanying drawing shows the plan, which, with the assistance of Mr. George Whitelaw, Mr. James Whitelaw has invented for keeping the new patent water-mill out of tail-water. *a a* is the main-pipe, *b b* are the arms of the machine, and *c* is the top of its shaft. The arms work inside of an air-vessel *ff*, which is fixed down to a building, and is covered on the top, but has no bottom. The shaft passes freely through a hollow cylinder fixed above an opening in the top of *ff*, and there is another hollow cylinder *i i*, fixed also on the top of *ff*, and so large in diameter inside as to leave room for a third cylindrical part *e*, which is fixed upon the upright shaft to revolve easily in the space left between the other two cylinders. The top of *ff*, forms a bottom to the space which is between the two cylindrical parts first named, and *e* is fixed upon the shaft in such a manner that the joining will be air-tight. An inspection of the drawing will make the arrangement, &c., of the cylindrical parts intelligible. *g* is one side of the tail-race; *s* is the opening through which the water escapes from *ff*, into the tail-race.

Suppose now the space into which the cylinder *e* works sufficiently filled with water to form an hydraulic joint of the kind very commonly used in gas works; then, if the machine is set in motion, the air, which will in some instances be disengaged from the water, will remain in the vessel *ff*, and press down the surface of the water in it to the level *n n*, or even lower. In this way, the arms of the machine, although on a level below that of the surface *m m*, of the water in the tail-race, will work clear of the tail-water.

It may be found necessary to use a small pump to force air into *ff*, in order to lower the surface of the water. By running a quantity of water from the main pipe into the air-vessel through an arrangement of pipes similar to the water-blowing machine, air will be carried into *ff*. The space within which the cylinder *e* works may be supplied with water by a small pipe leading from *a a*.

A water-mill composed of two round plates, the one forming the top, the other the bottom of the passages for the water, with plates on edge and properly bent, running between them from the centre outwards, so as to make the space between the round plates all into arms, will work very well in tail-water. If a ring, projecting downwards is fixed to the under plates, then the bottom of the machine will rub on a film of air, instead of on water, and thus the friction will be diminished. This plan may be used instead of the one herein described, in certain cases.

IMPROVED JACQUARD APPARATUS.

A machine has recently been added to the mechanical department of the Salford Mechanics' Institution which promises for it a great increase of attraction. It is an invention of a gentleman of this town, and is called a Jacquard apparatus. When appended to looms moved by power (as in the present instance), or otherwise, it is capable of producing, either on light or heavy fabrics, not only a greater variety, but also a wider and more extensive range of pattern than any other kind of loom; it makes a top and bottom shed of any required depth, without the aid of weights and springs being attached to the healds. The design is formed, and may be varied at any moment by the application of paper cards, or wooden logs and pegs. It will weave with any number of shafts, from 2 to 30; and any length of pattern, up to 5,000 picks may be produced by it. The invention is a very important one to manufacturers. Other articles have likewise been added to the collection within the last few days, but our limits at present prevent us from adverting to them.—*Manchester Guardian.*

BIOGRAPHICAL NOTICE OF THE LATE MR. WILLIAM HAZLEDINE, IRON FOUNDER AND CONTRACTOR FOR PUBLIC WORKS.

(From the Shrewsbury Chronicle.)

WITH deep and sincere sorrow we record the death of our respected and endeared townsman, the eminent iron founder, William Hazledine, on Sunday, October 26, at his house in Dogpole, in the 77th year of his age.

It would be almost criminal to permit such a man to drop into the grave like an ordinary human being, and therefore we hastily present a few incidents in his busy and honourable career through life.

William Hazledine was born at Shawbury, and his parents removed, while he was very young, to a house at Sowbatch, near a Forge at Moreton Corbet, now Moreton Mill, about seven miles from this town. His father was certainly not wealthy; but his ancestors were highly respectable, their remains occupying tombs in the church-yards of Shawbury and Moreton Corbet; and these tombs the deceased, with filial regard, caused to be repaired a few years ago; he also presented two handsomely carved oak chairs for the altars of both those churches.

During sixteen or seventeen of his early years he worked around the vicinity as an operative millwright. His uncle, under whom he was chiefly brought up, was a man of considerable ability as a millwright and engineer; and, discerning the steadiness and talent of his nephew, he recommended young Hazledine, only 16 or 17 years old, to superintend the erection of machinery at Upton Forge, the property of the Sundorne Family: this was executed most satisfactorily. He afterwards became the tenant of this forge, and the farm belonging to it, and so continued in after life.

After the patronage of his uncle he removed to Shrewsbury, and entered into partnership with Mr. Webster, in Mardol, then a clock-maker, but afterwards an ironmonger and the patentee of a washing-machine. Their first foundry was in Cole-hall, or Knucking-street, in this town; but the speculative and energetic mind of Hazledine having increased the business, more space for workshops, and an increased expenditure for that purpose, amounting to about 2,000*l.*, were necessary: his partner being cautious and timid, a dissolution of partnership took place.

Mr. Hazledine purchased the ground in Coleham, where his present foundry is situated, which has now four gables fronting the road. He prudently first erected one workshop, which occupied only one of these gables; but as business increased he extended his shops, and numerous other erections in the vicinity. He subsequently occupied a foundry near Ruabon, iron works at Calcott, lime works at Llanymynech, timber yards, brick yards, and coal wharfs, in various places.

About this time Billingsley iron mines, near Bridgnorth, were offered for sale in Chancery. Hazledine attended the sale in London, and found there was some jockeyship employed to depreciate the property, and prevent the sale, certain parties being anxious to purchase the works without any competition. Hazledine's sagacity saw the trick; he bid with spirit: at length one of the parties, who wanted to purchase, came to him, and whispered—

"Do you know what you are doing? These mines and works have not a good title, and you will have to pay the expenses in Chancery if you purchase them."

In an audible voice Hazledine answered—

"A bad title to the property, is it, eh? and a Chancery suit, too, eh? Well, I have bought many things, and I will now try to buy a Chancery suit.

He did purchase the property, but immediately sold it, gaining several thousand pounds. The property finally turned out ruinous to the speculators.

In November 1804, at midnight, a fire took place in a room which was the receptacle for his patterns for castings. Mr. Hazledine was from home, but his wife (a daughter of Mr. Brayne, of Ternhill), an uncommonly strong-minded woman, heard the cry of "Fire in Hazledine's foundry," whilst in bed with her infants, and immediately getting up, gave directions for saving the books, papers, and other valuables, which caused their rescue from the flames, whilst a vast quantity of other property was consumed with the building. Mr. Hazledine was then the captain in a company of volunteers; and his company, comprising chiefly his own workmen, was merrily called "The Vulcans." The colonel, Sir Charles Oakely, Bart., and the whole corps, were roused, and much property was saved. It was estimated that the loss was 1,500*l.*, and that about two-thirds were covered by insurance.

Undaunted by the calamity, he rebuilt and extended his foundry, and carried on his various speculations, above enumerated, with great energy. Thomas Telford, who in after life became the celebrated en-

gineer, had been patronised by Sir William Pulteney, and employed in reconstructing some parts of "The Castle" in Shrewsbury, became acquainted with Hazledine, and these kindred spirits formed an intimacy which lasted through life.

Telford soon after was engaged in constructing the Ellesmere and Chester Canal, and Mr. Hazledine became the contractor for the Chirk and Pontycyssylte Aqueducts, the latter being one of the most magnificent works of the kind in Europe, which he completed so entirely to the satisfaction of Mr. Telford and the proprietors, that he was immediately engaged in all the national works in which the Government at that time plunged. The erection of the stupendous locks on the Caledonian Canal was entrusted to him, and executed to the entire satisfaction of the engineer and the country.

Hazledine's fame was now established, and he was employed in a series of great works. The following is a summary:—

Pontycyssyle cast-iron Aqueduct over the river Dee, and the valley at Llangollen, in 1802.

A Bridge, 150 feet cast-iron, over the river Bonar, in Scotland.

A Bridge, 150 feet ditto, over the river Spey, in Scotland.

The Lock-gates on the Caledonian Canal.

The beautiful Waterloo Bridge, 105 feet span, near Bettws-y-Coed, on the Holyhead road.

The iron Swivel Bridges at Liverpool Docks.

The Liverpool New Market Columns.

A Bridge, 150 feet span of one arch, and two arches of 105 feet, over the river Esk, near Carlisle.

The Menai Suspension Chain Bridge.

The Conway Suspension Chain Bridge.

The Iron Roofs for the Dublin Custom House and Store-houses.

The Iron Roofs for Pembroke Stores, &c.

Many Swivel Bridges for Sweden.

A large quantity of three-feet Pipes for India, Demerara, &c.

A Bridge built for Earl Grosvenor, 150 feet, at Eaton Hall.

A Bridge over the Severn at Tewkesbury, 170 feet span.

A new Bridge over the Dee, 105 feet span.

A Bridge for Earl Morley, at Plymouth, comprising five arches, of 100 feet, 96, and 81 feet span.

A Bridge at Bath.

Holt Fleet Bridge, 150 feet, over the Severn, near Worcester.

The Swivel Bridges at the London Docks.

The Marlow Chain Bridge.

Montrose Chain Bridge.

Several small Iron Bridges in this county, and many others all over the kingdom, besides the Lock-gates on the Ellesmere and other Canals.

At the present moment, Hazledine's foundry is executing a very extensive work, namely, several pairs of iron lock-gates for Newport, in Monmouthshire, South Wales, each pair weighing 120 tons, the largest ever executed.

In 1832, when the present Queen, then Princess Victoria, and her august mother, the Duchess of Kent, honoured the Earl of Liverpool with a visit at Pitchford Park, near this town, Mr. Hazledine had the honour of receiving, through the Earl of Liverpool, the commands of the Royal personages to wait upon them at Pitchford Park, and explain the principles and construction of the Menai Suspension Bridge —Hazledine's greatest work. The Royal party expressed great satisfaction at the lucid and instructive manner in which the explanations were given, and the tact and shrewdness displayed in Mr. Hazledine's answers. Persons who were present describe the interview as most interesting. Mr. Hazledine received a present as a token of approbation; and we cannot avoid adding, from personal knowledge, that her Royal Highness the Duchess of Kent, when she passed over the Menai Bridge, examined every part of it minutely, according to Mr. Hazledine's description, and even entered the caves in which the iron suspension cables are fixed.

This is a slight view of Mr. Hazledine's public works, and it gives a portrait of him as a practical man. There are other features, which we are unable to paint with the warmth and fidelity which they deserve. His strong affection for the members of his family rendered his fireside one of the most happy round which an English family ever gathered. He was ever devising some simple means of increasing their enjoyments; and he attended personally to everything in which their comforts were involved. At that trying season, when the wheel of the "Union" coach locked into that of his gig on the Wyle Cop, and overthrew him and shattered his arm in several places, and he was carried home in such plight as threw his affectionate wife into such agony as deprived her of life by a disorder arising from the grief she suffered from his illness—even in that accumulation of sorrows his presence of mind and affectionate care never for a moment ceased; and whilst his face was suffused with sweat from the extreme agony he was suffering from the bone of his arm having to be *again* broken by the surgeon—even then he took upon himself the whole preparation for the funeral of his beloved wife, down to the minutest fittings up of the coffin and funeral clothes; and what all his own sufferings could not wring from him, he gave way to with the utmost bitterness when the dead body of her he so much loved was carried into his chamber, that he might kiss it before it was for ever removed from his sight!

As a master he was kind and considerate to all employed under him; his workmen, if they conducted themselves well, became grey, and died in his service. In our obituary last month we recorded the death of John Maybrey, sen., who had been upwards of 40 years in the employment of Mr. Hazledine, who, indeed, reminds us of Addison's character of Sir Roger de Coverley:—"You see the goodness of the master even in the house-dog, and in his *grey horse*, that is kept in the stable with great care and tenderness, out of regard to his past services, though he has been useless several years."

The religion of Hazledine was also somewhat characterised by Addison:—"Nothing is so glorious in the eyes of mankind, and ornamental to human nature—setting aside the infinite advantages which arise from it—as a strong, steady, masculine piety; but Enthusiasm and Superstition are the weaknesses of human reason—that expose us to the scorn and derision of Infidels, and sink us even below the beasts that perish."

A very short time before he was confined to bed by his last illness, a nobleman, equally distinguished by his literary and legal talents, and filling one of the highest situations which a subject can occupy, arrived in the town, at a little before seven in the morning, and inquired at the Lion if Mr. Hazledine was likely to be up?

"Oh yes," was the reply; "he passed here an hour and a half ago, on his way to the foundry."

"I regret that," said his lordship, "for I wanted a few minutes' conversation with him, which I cannot now have; but tell him from me, that Lord —— inquired after him, and is happy to hear he is so well. My belief is," added his lordship, "that William Hazledine is the first practical man in Europe."

PROPOSAL FOR ESTABLISHING A BRITISH ASSOCIATION FOR THE ADVANCEMENT OF THE FINE ARTS.

A knowledge and consequent due appreciation of the fine arts,—the arts which purify and ennoble,—are now observable amongst much larger masses of persons in the metropolitan cities of the United Kingdom, than was the case twenty years ago; and must inevitably go on to augment in a greatly multiplied ratio, as every step gained becomes the means of further advances. In the provinces, too, where there are fewer "appliances and means to boot," the attention of the people to the importance of the fine arts as civilizing agents, and as tending to promote the general good and therefore the general happiness, has visibly increased, and has manifested itself in more than one good result. Still there is a wide field here open for exertion; and so undeniably important is the object to be attained, so vast is the good that would result from spreading a taste for the fine arts throughout the country, and inculcating a love of the beautiful, that no efforts could be too great, no scheme of operations could be too extensive, which should propose to effect it.

Experience shows the advantages which have resulted from the establishment of the "British Association for the Promotion of Science," not chiefly to science *per se*, although these have been great and manifold, but to the people generally: attention has been awakened in the minds of thousands to subjects before unthought of; a spirit of inquiry has been induced: and whole towns innoculated with an admiration of knowledge, and a determination to pursue it, to the exclusion of demoralizing sources of excitement, until then indulged in. Why, then, might there not be formed an association for the encouragement of ART, which, like this, should meet annually at a different town in England, Ireland, or Scotland, and at which meeting painting, poetry, sculpture, architecture, &c., &c., in all their varieties, and with all their ramifications, should form the subjects for the consideration of the different sections. A large and important exhibition of works of art might be collected, and an Art-Union arranged so as to secure the sale of a certain number of them, and thus to ensure the assistance of the most eminent artists, by rendering the society directly as well as indirectly advantageous to them. A small subscription (say of one pound) would constitute a member of the association for the year, the aggregate of which, after deducting the expenses necessarily incurred, would probably enable the committee (which should be partly local, partly general) to offer prizes for competition in the higher branches

of the various arts, and vote sums for the encouragement of any desirable object, in connexion therewith; such, for example, as for the prosecution of experiments in the preparation of colours, the manufacture of stained-glass, or for the purchase of particular pictures, worthy of national regard.

During the meeting the various local collections would be thrown open to inspection; conversazioni would be held; and other means adopted to bring men into contact with each other, on one common ground. One of the first points to be achieved by the united sections would be, to obtain an able and correct report of the progress of Art in England, Ireland, and Scotland, for the last fifty years—a task to be fulfilled satisfactorily only by the joint co-operation of men in all parts of the country. This report would afterwards be continued from year to year, under its various heads, and could not fail to prove a work of the highest interest and value. It is not here attempted, however, to point out what *could* be done by a society organized on the footing suggested: its power of effecting much good must be apparent to all, and needs hardly to be insisted on. The writer is contented simply, but with great earnestness and but one object,—namely, strong desire to serve the cause the Art (the cause of morality and public good), to state the proposition, in the hope that others of more ability, influence, and leisure, may view it as it has appeared to him; and be induced to carry it into execution, efficiently and forthwith.

GEORGE GODWIN, JUN.

Pelham Crescent, Brompton,
January, 1841.

WOOLF'S DOUBLE CYLINDER ROTARY ENGINE.

SIR—In your number for December last, I read a very interesting account of the communication made at the annual meeting of the Manchester Geological Society, by Mr. William Fairbairn; Mr. Fairbairn paid a just tribute of praise to the late Mr. Woolf, by acknowledging the real services rendered by his single engine in Cornwall particularly, and to science generally, in consequence of the undoubted progress made by his application of high pressure steam employed expansively. Mr. Fairbairn's remarks were the more gratifying, inasmuch as the exertions of Mr. Woolf appear generally to be in a state of perfect "oubli," although there can be very little doubt, that he was the first after Mr. Watt to give an impulse to the progress of the Cornish engine, and that much more is due to him than has been generally acknowledged, this circumstance reflects honourably on Mr. Fairbairn's proceeding, to whom much praise is due for his just observations, and for bringing before society a name that is little known, and more honoured abroad than at home.

The principal object of my present application to you is to request, that you will give place to the following observations relative to Mr. Woolf's double cylinder rotary engine, which being but little used in England, has been hitherto very much neglected. I am of opinion that this engine, if better known, and if patronized by engineers of enterprising genius, and in "good repute," would very generally be preferred to every other known system: I speak after having had long and solid experience, and having been in the habit of actual observation abroad, on many hundreds of engines upon different systems, I can very confidently assert, that Woolf's engines when properly made, will work quite as well as any other engine, and will perform the same duty with a consumption of coal that will not exceed *five pounds* per horse power per hour; I have seen many engines of this description doing very satisfactory duty with less.

I have had several opportunities of conversing with manufacturers, who having had low pressure engines, have contracted with engineers to have their cylinders and boilers replaced for the purpose of applying Woolf's principle, and they have invariably declared that they have effected a saving of upwards of one half of the fuel.

I will cite for example an engine on Woolf's principle erected in a mill for rolling zinc and lead, and for drawing pipes. The dimensions of this engine were as follows.

Area of small cylinder, 207·39 square inches.
Stroke of small piston, 4·59 feet.
Speed of piston per minute, 176·34 feet.
Area of big cylinder, 660· square inches.
Stroke of big piston, 6·3 feet.
Speed of piston per minute, 242· feet.
Pressure of steam in the boiler tending to escape into the external atmosphere, 40 lb. per square inch.

The capacity of the small cylinder naturally determines the quantity of steam that the boiler must supply, and allowing that the cylinder fills with steam of an elastic power equal to that in the boiler, and admitting that the big cylinder produces the same effect as the cylinder of an ordinary low pressure engine, the total power of the above engine may be computed in the following manner.

Area of each cylinder in square inches, × pressure of steam per square inch, × speed of piston in feet, and the product divided by 33000 lb. one foot high per minute per horse power, will give the computed power of each cylinder.

$$\text{Small cylinder } \frac{207{\cdot}39 \times 40 \times 176{\cdot}34}{33000} = 44{\cdot}32 \text{ H. P.}$$

$$\text{Big cylinder, } \frac{660 \times 10 \times 242}{33000} = 48{\cdot}40 \text{ H. P.}$$

Computed power of the engine $= 92{\cdot}72$ H. P.
If we deduct for friction one-third $= 30{\cdot}92$

The effective power will be $= 61{\cdot}8$ H. P.
I will call her a 60 horse engine.

To ascertain the quantity of coal this engine will burn, it will be requisite to determine the quantity of water that must be evaporated, to produce a sufficient supply of steam, which can be done as follows:

$$\frac{\text{The area of the small cylinder in sq. inches} \times \text{by the speed in feet}}{144} =$$

capacity of small cylinder in cubic feet per minute.

$\frac{207{\cdot}39 \times 176{\cdot}34}{144} = 254$ cubic feet, representing the space occupied by the action of the piston in one minute, and if we add thereto one-tenth for the steam ways, and the space between the top and bottom of the cylinder and the piston, we shall find that the boiler must supply per minute, $254 + 25{\cdot}4 = 279{\cdot}4$, or say 280 cubic feet of steam, under a pressure of 40 lb. per square inch, and per horse $280 \times 60 = 16800$ cubic feet of steam.

One cubic foot of water converted into steam of an elastic form equal to 40 lb. per square inch, will occupy in the shape of steam about 520 times the original volume, consequently the 16800 cubic feet of steam that will be requisite per hour, will be the produce of $\frac{16800}{520} =$ 32·31 cubic feet of water per hour.

$$32{\cdot}31 \times 62{\cdot}5 = 2020 \text{ lb. avoirdupois.}$$

Suppose 1 lb. of coal to evaporate 8 lb. of water, and Messrs. Parkes and Wicksteed have proved that more can be done, but allowing 8 lb. as a fair proportion, the hourly consumption of coal would be

$$\frac{2020}{8} = 252{\cdot}5 \text{ lb. of coal per hour,}$$

$$\text{and } \frac{252}{60} = 4{\cdot}2 \text{ lb. of coal per hour per horse power.}$$

I am aware that nothing in the above computation has been allowed for leakage by the piston, but with a good and true cylinder, and a well fitted piston, very little steam will pass—and if 5 lb. of coal are allowed instead of 4·2 as above, the difference will more than compensate for any loss of this kind.

The above engine was for a considerable length of time doing only 40 horses work, and her average consumption of coal was 1 hectoliter, or 80 kilogrammes of coal of a medium quality per hour, or 2 kilogrammes per hour, and per horse power—2 kilogrammes = 4·41 lb. avoirdupois.

Should you consider these remarks to be worthy of a place in your very useful Journal, you will much oblige,

Your very humble servant,

London, Jan. 14, 1841. H. H. E.

Important to Builders and others.—It may not be generally known that an Act of last Session imposed certain restrictions on the mode of building chimneys, with the view of rendering climbing boys unnecessary in cleansing flues. It is thereby enacted that after the passing of the Act, "all partitions between any chimney or flue shall be of brick or stone, and at least equal to half a brick in thickness;" such partition to be of sound materials, "and the joints of the work well filled in with good mortar or cement, and rendered or stuccoed within;" "that such chimney or flue in any wall, not being a circular chimney or flue 12 inches in diameter, shall be in every section of the same not less than 14 inches by 9 inches." The angle at which it is lawful to build any chimney is also determined. Another clause enacts "that from and after the first day of July, in the year 1842, any person who shall compel or knowingly allow any child, or young person under the age of twenty-one years, to ascend or descend a chimney, or enter a flue, for the purpose of sweeping, cleansing, or coring the same, or for extinguishing fire therein, shall be liable to a penalty, not more than ten pounds, or less than five pounds."

LIVERPOOL DOCKS.

Sir—I beg to forward the annexed extract from the "Liverpool Standard" newspaper for insertion in your valuable Journal. My reasons for so doing are:

1st. From personal respect to the talented engineer whose name it bears.

2nd. That the very important document may be preserved, and read by the greatest possible number of individuals at all interested in similar matters. Such documents are very scarce, and very probably this would not have existed, but for the *very extraordinary circumstances* which *demanded* such in defence.

3rd. As a beacon to others, shewing the necessity of always being prepared for similar attacks.

And lastly. To just drop a hint to all the eminent engineers, whether British or Foreign, who may have examined the important works at the Liverpool Docks—works which have been "designed and constructed by the energies of his (Mr. Hartley's) own mind alone, unaided by the designs, arrangement, or superintendance of any other civil engineer." I say just a hint to such persons, that they may lose no time in committing their opinion of the works in question to paper, and forward them to you for insertion in your Journal.

When little dogs bark, it is best to walk away and heed them not; but when great dogs bark and shew their teeth, (especially when they want a bone with a little flesh on it to pick,) there is great danger of their biting; then is the time for defence.

Your insertion of the above, together with the annexed defence, will oblige

Your obedient servant,

Warrington, A Lover of Fair Play.

1st Jany., 1841.

"To the Chairman and Members of the Dock Committee.

"Gentlemen,—I feel called upon, not only as a mark of respect to those various gentlemen who have composed the Dock Committee during the sixteen years I have had the honour to fill the situation of Dock Surveyor, but also in justification of myself, to make some remarks on the notice of a motion given by Mr. Chapman, at the last meeting of this Committee, as well as to the charges brought against me by him in so abundant and unqualified a manner, both previous and subsequent to his giving notice of that motion.

"It was, I believe, and I do not wonder at it, a subject of surprise to many, that I did not say more in my defence. It was not, however, from a deficiency of matter, but from an overpowering feeling of astonishment at the sudden and unqualified torrent of assertions, charging me with incompetency, incorrect statements, &c., with which I was assailed.

"Had I only to reply to the individual member who made these charges, I might think it proper to take a different course, and should probably simply refer him to the books and resolutions of this committee; but as his charges reflect not only upon me, but upon this committee, upon those who composed the committee before you, as well as upon those who elected me to the office I hold, I think I am bound to rebut them, in doing which I anticipate little difficulty.

"In the first place, I am charged with incompetency and ignorance of my profession, upon which is founded the motion, 'That a first-rate engineer be appointed, to furnish designs for new works, and superintend their construction.'

"In answer to this charge, I will not refer you to the testimonials which procured my appointment to this situation from amongst numerous candidates, without my having had any previous knowledge of any gentleman forming the then council; but I will refer you to those important works which I have constructed since I have filled the situation I hold, from my practical knowledge as a civil engineer, and from the energies of my own mind alone, unaided by the designs, arrangement, or superintendence of any other civil engineer, and which, I may be allowed to say, so far from being considered evidences of *incompetency*, have elicited the admiration of civil engineers of the highest standing, both of our own and foreign nations. I will also refer you to the proceedings of the Dock Committee since my appointment, and during the progress of those works, and I will ask the member who has brought forward these charges, whether he has found in those proceedings (which, of course, he made himself master of before bringing such charges) any resolutions accusing me, in the most remote manner, with incompetency, or casting the slightest stain upon my character? and I will ask him further, to mention an instance in which those interested in the working of the different designs I have furnished and executed, have made a complaint of the inefficiency of those designs, or of their construction, to this committee, until his becoming a member of it, and bringing forward objections against a work, the first of the kind yet executed here or elsewhere, which had been in progress for several months, which had received the approbation of the authority next to be consulted by me after the committee (I allude to the Master of the Graving Docks), and in which, on the 31st July, when partly completed, one of the large steam ships was docked, shored, and the necessary work effected, without a complaint having been made, or an objection offered?—a practical proof of its *not being unsafe for life or property.*

"With reference to the several assertions made by the member concerning this graving dock, which have gone through the newspapers before the public—'That if the large steam-boats, for which this dock was expressly constructed, went into it, their paddle-boxes rested on the quays, and their keels did not touch the blocks by 14 inches,' and also, 'that the sill had been broken up'—I would beg, in the first place, to observe, that the extreme width of the largest steam-ship that has yet come to this port (the President), is, according to the dimensions furnished me, 66 feet 8 inches from outside to outside of paddle-boxes,—whereas the width of the graving dock, from the edge of one quay to that of the other, is 71 feet 6 inches, which proves that the paddle-boxes *could not touch the quay by 2 feet 5 inches on each side,* and secondly, that the *sill* of the dock *has not been altered.* The alterations alluded to by the member, which caused the taking up of the masonry, was an improvement in the original design, but no error, and was totally unconnected with the sill, and partly composed of the original masonry of the former graving dock which had not previously been touched.

"From the blame of having neglected to procure the dimensions of the largest steamers until the work was so far advanced, I think the chairman of this committee can fully exculpate me. With regard to the allusions made by the member, to the south graving docks and Coburg Dock, I have to observe that those matters have been previously canvassed,—but it may be as well to state here, for the information of all, that what the member blames me for, concerning the south graving docks, is what was expressly contemplated in their construction, viz., the increased depth of their silts, to admit of the admission of the heaviest ships coming to the port, at a lower tide than the old graving docks would permit; but if vessels are allowed to be taken in by the carpenters at all tides, it cannot be expected, by any who have paid attention to the tides here, that a sill lying 2 feet 6 inches below the level of the old dock sill, can be laid dry at a low neap tide, which does not ebb within a foot of the level of that datum, unless recourse be had to mechanical assistance. And as to my desire to put reverse gates to the passage leading into the Coburg Dock, that was *an addition to,* but certainly not an alteration of, or error in, my original design; neither did I report 'that the dock was complete, after which it was found that it required deepening,' as asserted by the member, my report to the committee being as follows:—'The Coburg Dock has been completed, *excepting a portion of its bed, which is not yet sufficiently deepened,* but is expected to be all finished in September, chiefly with dredging machines,' and that report would have been borne out, had it not been from the desire to afford the earliest accommodation to the large steamers which have since almost continually occupied the dock, often greatly to the hindrance of the dredging machines.

"I will also beg leave to mention, that so far from my having been considered incompetent by others, I have at various times been requested to exercise my profession in similar and other works, both here and in several other parts of the kingdom; and I may also remark, in noticing the second portion of this motion, that although the terms of my appointment gave me full liberty to exercise my profession elsewhere, yet so closely have I devoted my time to the dock works, as not to allow myself any leisure to accept other engagements, excepting such as my son's assistance enabled me to do, without requiring any lengthened absence from the duties of my situation; and I would wish the member to name any instance in which I have heretofore been accused of non-attendance to, or neglect of those duties; indeed, so far has the contrary been the case, that during the last three years I have not been in the whole more than 15 days absent on private business, and the most of those days I have been but partially absent. In concluding my notice of these charges, I would beg leave to call to your remembrance the circumstance of my having been presented with the freedom of this town *as a mark of the Council's approbation of my conduct as Dock Surveyor.*

"The other charges made against me by the member, and the implication contained in the first part of the motion given notice of, backed as it was by many assertions of impropriety in the expenditure of my department, need not, I think, require any lengthened refutation. With regard to the first of these, personal attacks of this description are easily made on any one filling a public situation, and however unjust they may be, cause great annoyance to those unfortunately subjected to them. In the present case the effect ceases there. I have been too long a public servant here and elsewhere, too long open to the scrutiny of all, to feel afraid of my character suffering from any assertion or observation the member can or has made; and I shall content myself with simply assuring this committee, that in all my statements to them I have invariably adhered to what I have believed to be the truth.

"As respects that part of the motion, stating an increased vigilance in the superintendence of the expenditure in my department to be necessary, taken in the abstract, I have nothing to say against it; on the contrary, too great a vigilance cannot be had to please me, as it will consequently, in like proportion, relieve me from care and responsibility. But taking this part of the motion in the spirit in which it is brought forward, and coupling it with the personal allusions made in bringing it before you, I should have considered it the most serious part of the attack upon me, and should have felt great anxiety to have disproved it most fully, had it been made by any gentleman of experience in the proceedings of the Dock Committee; but when I recollect that it is made by a member who has but recently joined the committee, and who has not yet given himself any opportunity of inquiring into the manner in which the expenditure he alludes to, in my department, is made,

never having yet been to my office to ask any explanation or information as to our accounts or method of business, I think it best to refer it to your own judgment, what foundation he has for his assertion, 'that at least a saving of £10,000 a year may be made in my department, *by a different method of carrying on the work*.' I feel, therefore, very easy in leaving my character in your hands, to most of whom I have been known so long, and under whom, until now, I have filled my situation free from all ungenerous attacks or uncourteous treatment. In concluding, I beg leave to quote the following extract from the printed copy of the Inquiry into the affairs of the Corporation of Liverpool, before the Parliamentary Commissioners—'Twelfth day. Mr. Alderman Lawrence said, he was glad to find it was not considered necessary to put any questions to Mr. Hartley, the Dock Surveyor; as an expenditure of £1,400,000 or £1,500,000 had passed through that gentleman's hands, he deemed that circumstance highly complimentary. Mr. Duncan said, he did not know a more deserving officer than Mr. Hartley; the rate-payers were perfectly satisfied with him,' &c.—and to remark, that that opinion, unqualified, uncontradicted, and expressed at such a time, is not exactly in accordance with the member's statement, 'That you will find you have spent as much money in rectifying my errors as the docks themselves have cost.'

"Finally, I take the liberty of calling your attention to a resolution of the Dock Committee of the 31st October, 1836, come to on the reading of my report to them of the 25th of the same month, and to that report I would beg especially to refer the member bringing forward the motion:—

"At a meeting of the Dock Committee, 31st Oct., 1836, present, Charles Lawrence, Esq., chairman, &c. &c., a printed copy of the Surveyor's report having been laid upon the table, in compliance with the directions of the last committee—

"'*Resolved*,—That the committee have read with much satisfaction the able report of the Surveyor upon the state of the works, and regret that, from the shortness of the time since which this report has been delivered, they are not able to enter into any minute investigation of its various details. They feel it quite unnecessary to express any encomium upon those magnificent works which will speak for themselves, and remain a lasting memorial of the great talents of Mr. Hartley. The major part of this committee being about to be removed by an act of the legislature, cannot relinquish their trust without availing themselves of their last meeting to record their high sense of the indefatigable zeal and great ability with which that gentleman has for more than twelve years executed the very important duties of his office, and they beg him to accept their sincere acknowledgments and thanks.

"'Extracted from the proceedings.

(Signed) "'CHARLES LAWRENCE, Chairman.'

"Having thus disposed of such of the charges and assertions made by the member as I think it necessary to notice, I feel that it would be an act of injustice to this committee to court a stricter investigation of the various details of my department than they have already received; and the unimportance of the charges which have been made ought, I imagine, to have been a sufficient protection against such an attack as I have been subjected to. If not, the further defence must rest with the committee, not with me.

"It now only remains for me most respectfully to request this committee to do me the justice of calling upon the member to prove his assertions, so serious in their nature, and to hope that this defence may meet with the same publicity as was given to the charges against me.

"I have the honour to be, gentlemen,

Dockyard, Liverpool, JESSE HARTLEY, Dock Surveyor.
10th Dec., 1840."

RAILWAY COMMUNICATION WITH SCOTLAND.

Third Report of Lieutenant-Colonel Sir Frederick Smith, of the Royal Engineers, and Professor Barlow, to the Treasury, in pursuance of the Addresses of the House of Commons of the 14th and 20th August, 1839.

Railway Committee Office, James-street, Buckingham-gate, 14th Nov. 1840.

SIR—The report which, in obedience to the instructions of the Lords Commissioners of the Treasury, dated the 26th of November, 1839, we had the honour to transmit to you on the 16th May last, respecting the competing lines for a railway communication between London and Glasgow, contains a distinct expression of our opinion, that of the three projects which had been submitted to us for that portion of the distance which extends from Lancaster to Carlisle, the preference was due to the project brought forward by Mr. Larmer, for a railway up the valley of the Lune, and by Orton and Penrith.

We, however, observed that this line would not extend to the district of Kendal the benefits of railway communication; and being aware that this thriving town would not only afford great support to any railway passing near it, but at the same time derive important advantages from such a mode of transit, we had directed the attention of the surveyors to this subject, and suggested the expediency of fresh surveys being made, in order to ascertain the practicability of uniting Mr. Larmer's project by the valley of the Lune with that of Mr. Bintley by the valley of the Kent, so as to carry the line within a short distance of the town of Kendal.

It appears that nearly at the period when our report on these northern lines was forwarded to you, some gentlemen connected with Kendal, and who are very desirous of carrying a railway near to that town, employed Mr Larmer to re-survey the valleys of the Lune and Kent, and to examine the ground which separates these rivers to the north of Kendal. The result is, that this gentleman has considerably modified and improved that part of Mr. Bintley's line which is to the south of Kendal; he has also made some slight alterations in that part of his own line lying between Orton and Low Borrowbridge; and he has laid before us a plan and section for a line to be formed through the pass which intervenes between the Grayrig Fell and the Lambrig Fell, and connects the valleys of the Lune and Kent.

Mr. Larmer terms this new line the "Grayrig Junction," and, for the sake of distinction, we shall give the title of the "Grayrig Line" to the whole project on which we are now about to report, pursuant to the instructions we had the honour to receive from you, dated the 29th May last.

The two principal points which we have kept in view in this investigation are, to determine how the construction of the railway, according to this combined project, would affect the traveller between London and Carlisle; and secondly, whether it would entail an increase of expense more than commensurate with the advantages to be derived from the line passing the town of Kendal.

In our last report, we stated that the locomotive power requisite to work the Lune line, expressed in horizontal distance, would be 78 miles and one chain; and we find, that by the Grayrig line it would be 78 miles and 62 chains.

This increase of 61 chains is not sufficient to form an important objection to the Grayrig project, as regards the traveller between London and Carlisle.

In the appendix (A) we have given a copy of a comparative estimate, submitted to us by Mr. Larmer, of the probable cost of the Lune line, and the Grayrig line.

As we are not in possession of cross sections of the ground where the heavy cuttings and embankments would be formed, nor of borings where the former would be necessary, and as we have also not been supplied with drawings of the bridges, viaducts, &c., it is not in our power to pledge ourselves to the positive accuracy of these estimates; but we think the details given are sufficiently correct to test the relative cost of the two projects; and there does not appear to be any reason for doubting Mr. Larmer's statement, that the Grayrig project would not require a capital of more than £126,219, 7*s*., beyond what would be necessary for that of the valley of the Lune.

In our former report on the lines between Lancaster and Carlisle, in estimating the population within ten miles of each route, the population of Kendal was considered as belonging both to the line of the Kent and to that of the Lune; and, according to this arrangement, the former was stated to be likely to afford railway accommodation to a population one-tenth larger than would derive this advantage from the latter.

The Grayrig line would accommodate a still larger number of persons than the original line of the Kent, as it would include the greater part of the population which gave the latter, under this head of comparison, the superiority over the original Lune line, and in addition would include the inhabitants of Ravenstonedale, Kirkby, Stephen, Brough and Appleby, to which the original Kendal line had no title. Thus the Grayrig line will have a decided superiority over the line of the Lune on the score of population, and therefore the traffic on the former, on this account alone, might reasonably be expected to be greater than on either of the other lines; but when it is considered that a line to Kendal would bring the lake tourists to within eight miles of Windermere, it may be fairly presumed that the number of passengers on this line would be much greater than on its competitors.

Kendal, as a commercial and manufacturing town, is of great importance in the county of Westmoreland, and there is no doubt that on the formation of a railway by the Grayrig Line, the supply of coal for the Kendal district would be almost exclusively derived from Carlisle; indeed it has been shown to us that a revenue of £10,000 a year may be expected from the carriage of coal alone.

In considering the relative merits of the three projects, we find that the Lune line has a small addition over the other lines in regard to saving of distance and economy of construction, but it has the defect of depriving the important town of Kendal of direct railway communication, and embraces a smaller population.

The great objection to Mr. Bintley's line was a summit tunnel of an almost impracticable character.

The line now proposed possesses the principal advantages, and is free from the chief defects of the other projects, and we therefore recommend it in preference to either.

We shall now proceed to give a general description of the line which we thus recommend for adoption.

In our report of the 16th of May, it was stated that Mr. Bintley proposed to form a junction with the Preston and Lancaster Railway, at a point about two miles and 54 chains south of the terminus at the latter place, and to pass under the town of Lancaster by a tunnel.

Mr. Larmer in commencing at the Lancaster terminus, very materially improves this line, as he thereby saves two miles, and 54 chains of construction, and avoids the inconvenience and expense of a separate station; and by keeping to the east of the line proposed by Mr. Bintley, he is enabled to dispense with the tunnel under the town of Lancaster, which was a great defect in Mr. Bintley's project.

The following table exhibits the gradients on the two lines up to Kendal, from which it will appear that the line as revised by Mr. Larmer is in that respect superior to the original line of Mr. Bintley.

Mr. Bintley's Original Line.

Miles.	Chains.			Remarks.
1	16½	fall	1 in 133	Remarks.—Commencing at the distance of 2 miles and 54 chains south of the London terminus.
1	54	..	1 in 221	
1	79½	rise	1 in 585	
1	35½	fall	1 in 263	
1	32	rise	1 in 389	
—	54	level		
—	75	fall	1 in 261	
2	17½	rise	1 in 140	
3	42	level		
—	40½	fall	1 in 206	
3	75½	rise	1 in 181	
2	72	..	1 in 153	
22	34			

Mr. Larmer's improvement of Mr. Bintley's Line.

Miles.	Chains.			Remarks.
1	35	fall	1 in 200	Remarks.—Commencing at the Lancaster station.
3	62	..	1 in 660	
2	50	level		
2	7	rise	1 in 160	
4	16	level		
1	76	rise	1 in 170	
3	—	..	1 in 160	
1	23	..	1 in 150	
20	29			

Although the gradients are in a slight degree more favourable according to the line as altered by Mr. Larmer, yet the cost of the earthwork will be rather greater, and Mr. Larmer will require a more expensive bridge for the crossing of the Lune, for its length will be about 600 yards, and its height 60 feet; whereas the bridge proposed by Mr. Bintley would not be above one-fourth of the length and one-half of the height of Mr. Larmer's.

However, this difference will be much more than compensated by the saving of the tunnel under the town of Leicester, and by the shortening of the line.

The deviations from Mr. Bintley's line, proposed by Mr. Larmer, are not of sufficient importance to require to be particularly mentioned here.

The direction of the line recommended is shown on the accompanying plan, by which it will be seen that it is intended to pass along the face of the high ground about a mile eastward of Kendal.

Mr. Larmer's junction line commences at a hamlet to the north of Kendal, called Scalthwaiterigg Stocks, whence it takes a north-easterly course, twice crossing the turnpike-road to the northward of Docker Garths and Mosedale Hall; it then proceeds nearly in an easterly course to the farm at Shaw-end. This point is the summit of the junction portion of the line, and is 562 feet above the level of the sea at low water at Lancaster, or 446 feet above the point of connection with the Preston and Lancaster Railway, the distance being 26¾ miles. Here a cutting will be requisite of two miles in length, in gravel and rock, and of the extreme depth of 52 feet, and of the mean depth of 35. This is the heaviest piece of work on the junction line.

From Shaw End the line tends more to the northward, and curving round the foot of some high ground, approaches the bank of the Lune near Dillicar Park, and converges towards Mr. Larmer's original line, which runs almost parallel to the river, up to Low Borrow Bridge.

Althouth the direction of Mr. Larmer's original and improved lines is nearly the same, yet such are the abrupt and precipitous forms of the hills that a considerable difference exists in the levels and gradients.

We subjoin a table of distances and gradients of the entire Grayrig line, and we have only further to remark, that, after an examination of the ground, we have thought it proper to suggest to Mr. Larmer the expediency of occasional breaks in his long gradients, for the purpose of easing the engine on the ascending planes, and of diminishing the earthwork in construction.

We do not consider it necessary to give minute details of the proposed line, as in the annexed copy of Mr. Larmer's report all the most important features of this project are fairly shown.

The heaviest work on the whole line is the Orton tunnel, which Mr. Larmer proposes to make of the length of one mile and 22 chains; but according to the section, in the accuracy of which we have full confidence, it appears that there will be heavy cuttings at both ends of the tunnel, the greatest depth being at one end 95, and at the other 98 feet.*

Now as we doubt the expediency of making a cutting in this instance of above 70 feet in depth, we are of opinion that it would be proper to extend the length of the tunnel to a mile and a half.

* The line of the tunnel in Mr. Larmer's original project was very accurately surveyed by Lieut. H. D. Fanshawe, of the 12th Foot, who reported hat the ground was fairly delineated in Mr. Larmer's section.

Table of Gradients of Grayrig Line between Lancaster and Carlisle.

Names of Places.	Intermediate distance.		Total distance.			Feet per mile.	Ratio.
Lancaster........	1	35	1	35	fall	26½	1 in 200
	3	62	5	17	fall	8	1 in 660
	2	50	7	67	level		
	2	7	9	74	rise	33	1 in 160
	4	16	14	10	level		
	1	76	16	6	rise	31	1 in 170
	3		19	6	rise	33	1 in 160
Kendal..........	7	45	26	51	rise	35	1 in 150
	2	65	29	6	level		
	2	74	32	30	rise	13½	1 in 400
	4	22	36	52	rise	35	1 in 150
Orton Tunnel	1	22	37	74	level		
	3	66	41	60	fall	35	1 in 150
	1	64	43	44	level		
	1	47	45	11	fall	17	1 in 310
	4	1	49	12	fall	26½	1 in 200
	1	69	51	1	fall	17	1 in 300
	1	55	52	56	rise	5	1 in 1056
Penrith	1	69	54	45	rise	3½	1 in 1650
	2	53	57	18	fall	21	1 in 251
	1	25	58	43	level		
	5	54	64	17	fall	25	1 in 210
Carlisle..........	6	—	70	17	fall	33	1 in 160

Mr. Larmer acquaints us that, on a careful examination of the Orton Hill, he has every reason to believe that the tunnel would pass entirely through sandstone; and as it would only be 340 feet below the summit of the hill, we have no doubt that this work might easily be completed in three years from the time of its commencement, under the supposition that Mr. Larmer has rightly informed us as to the nature of the rock through which the tunnel is to be formed.

We have the honour to be, Sir,
Your most obedient servants,
Frederic Smith, Lieut.-Col. R.E.
Peter Barlow, F.R.S.
Henry Amsinok, Lieut. R.N., Sec.

Robert Gordon, Esq., M.P., &c. &c. &c.

MEMOIRS OF SCIENTIFIC MEN.

The two following Memoirs are from the Address of the President delivered at the last Anniversary Meeting of the Royal Society.

James Prinsep, whose brilliant career of research and discovery has been closed by a premature death in the flower of his age, was Principal Assay Master, first of the Mint at Benares, and secondly of that of Calcutta, where he succeeded Prof. Wilson in 1833; he was a young man of great energy of character, of the most indefatigable industry, and of very extraordinary accomplishments; he was an excellent assayist and analytical chemist, and well acquainted with almost every department of physical science; a draughtsman, an engraver, an architect, and an engineer; a good oriental scholar, and one of the most profound and learned oriental medallists of his age. In 1828 he communicated to the Royal Society a paper "On the Measurement of High Temperatures," in which he described, amongst other ingenious contrivances for ascertaining the order, though not the degree, of high temperatures, an air thermometer applicable for this purpose, and determined by means of it, probably much more accurately than heretofore, the temperature at which silver enters into fusion. His activity whilst resident at Benares has more the air of romance than reality. He designed and built a mint, and other edifices; he repaired the minarets of the great mosque of Aurengzebe, which threatened destruction to the neighbouring houses; he drained the city, and made a statistical survey of it, and illustrated by his own beautiful drawings and lithographs, the most remarkable objects which the city and its neighbourhood contains; he made a series of experimental researches on the depression of the wet-bulb hygrometer; he determined, from his own experiments, the values of the principal coins of the East, and formed tables of Indian metrology and numismatics, and of the chronology of the Indian systems, and of the genealogies of Indian dynasties, which possess the highest authority and value. When transferred to Calcutta, he became the projector and editor of the "Journal of the Asiatic Society of Bengal," a very voluminous publication, to which he contributed more than one hundred articles on a vast variety of subjects, but more particularly on Indian coins and Indian palæography. He first succeeded in deciphering the legends which appear on the reverses of the Greek Bactrian

coins, on the ancient coins of Surat, and on those of the Hindoo princes of Lahore and their Mahomedan successors, and formed alphabets of them, by which they can now be readily perused. He traced the varieties of the Devanagari alphabet of Sanscrit on the temples and columns of Upper India to a date anterior to the third century before Christ, and was enabled to read on the rocks of Cuttock and Gujaret the names of Antiochus and Ptolemy, and the record of the intercourse of an Indian monarch with the neighbouring princes of Persia and Egypt: he ascertained that, at the period of Alexander's conquests, India was under the sway of Boudhist sovereigns and Boudhist institutions, and that the earliest monarchs of India are not associated with a Brahminical creed or dynasty. These discoveries, which throw a perfectly new and unexpected light upon Indian history and chronology, and which furnish, in fact, a satisfactory outline of the history of India, from the invasion of Alexander to that of Mohammed Ghori, a period of fifteen centuries, are only second in interest and importance, and we may add likewise in difficulty, to those of Champollion with respect to the succession of dynasties in ancient Egypt. These severe and incessant labours, in the enervating climate of India, though borne for many years with little apparent inconvenience or effect, finally undermined his constitution; and he was at last compelled to relinquish all his occupations, and to seek for the restoration of his health in rest and a change of scene. He arrived in England on the 9th of January last; but the powers both of his body and his mind seem to have been altogether worn out and exhausted; and after lingering for a few months, he died on the 22nd of April last, in the 41st year of his age. The cause of literature and archæology in the East could not have sustained a severer loss.

Simon Denis Poisson, one of the most illustrious men of science that Europe has produced, was born at Pithiviers on the 21st of June, 1781, of very humble parentage, and was placed, at the age of fourteen, under the care of his uncle, M. L'Enfant, surgeon, at Fontainebleau, with a view to the study of his profession. It was at the central school of this place that he was introduced to the notice of M. Billy, a mathematician of some eminence, who speedily discovered and fostered his extraordinay capacity for mathematical studies. In 1793 he was elected a pupil of the Ecole Polytechnique, which was then at the summit of its reputation, counting amongst its professors Laplace, Lagrange, Fourier, Monge, Prony, Berthollet, Fourcroy, Vauquelin, Guyton Morveau, and Chaptal. The progress which he made at this celebrated school surpassed the most sanguine expectations of his kind patron, M. Billy, and secured him the steady friendship and support of the most distinguished of his teachers. In the year 1800, he presented to the Institute a memoir, "Sur le nombre d'intégrales complètes dont les équations aux différences finies sont susceptibles," which cleared up a very difficult and obscure point of analysis. It was printed, on the recommendation of Laplace and Lagrange, in the *Mémoires des Savans Etrangers*, an unexampled honour to be conferred on so young a man. Stimulated by its first success, we find him presenting a succession of memoirs to the Institute on the most important points of analysis, and rapidly assuming the rank of one of the first geometers of his age. He was successively made Répétiteur ann then Professor of the Polytechnic School, Professor at the Collège de France and the Faculté des Sciences, Member of the Bureau des Longitudes, and finally, in 1812, Member of the Institute. His celebrated memoir on the *invariability* of the major axes of the planetary orbits, which received the emphatic approbation of Laplace, and secured him, throughout his life, the zealous patronage of that great philosopher, was presented to the Institute in the year 1808. Laplace had shown that the periodicity of the changes of the other elements, such as the eccentricity and inclination, depends on the periodicy of the changes of the major axis—a condition, therefore, which constitutes the true basis of the proof of the stability and permanence of the system of the universe. Lagrange had considered this great problem in the Berlin Memoirs for 1776, and had shown that, by neglecting certain quantities which might possibly modify the result, the expression for the major axis involved periodical inequalities only, and that they were consequently incapable of indefinite increase or diminution. It was reserved to Poisson to demonstrate *à priori* that the non-periodic terms of the order which he considered would mutually destroy each other—a most important conclusion, which removed the principal objection that existed to the validity of the demonstration of Lagrange. This brilliant success of Poisson in one of the most difficult problems of physical astronomy, would appear to have influenced him in devoting himself thenceforward almost exclusively to the application of mathematics to physical science; and the vast number of memoirs and works (amounting to more than 300 in number) which he published during the last thirty years of his life, made this department of mathematical science, and more particularly whatever related to the action of molecular forces, pre-eminently his own. They comprehend the theory of waves and of the vibrations of elastic substances, the laws of the distribution of electricity and magnetism, the propagation of heat, the theory of capillary attraction, the attraction of spheroids, the local magnetic attraction of ships, important problems on chance, and a multitude of other subjects. His well-known treatise on mechanics is incomparably superior to every similar publication in the clear and decided exposition of principles and methods, and in the happy and luminous combination of the most general theories with their particular and most instructive applications. Poisson was not a philosopher who courted tee credit of propounding original views which did not arise naturally out of the immediate subjects of his researches; and he was more disposed to extend and perfect the application of known methods of analysis to important physical problems, than to indulge in speculations on the invention or transformation of formulæ, which, however new and elegant, appeared to give him no obvious increase of mathematical power in the prosecution of his inquiries. His delight was to grapple with difficulties which had embarrassed the greatest of his predecessors, and to bring to bear upon them those vast resources of analysis, and those clear views of mechanical and physical principles in their most refined and difficult applications, which have secured him the most brilliant triumphs in nerrly every department of physical science. The confidence which he was accustomed to feel in the results of his analysis—the natural result of his own clear perception of the necessary dependence of the several steps by which they were deduced—led him sometimes to accept conclusions of a somewhat startling character: such were his views of the constitution and finite extent of the earth's atmosphere, which some distinguished philosophers have ventured to defend. It is not in mathematical reasonings only that we are sometimes disposed to forget that the conclusions which we make general are not dependent upon our assumed premises alone, but are modified by concurrent or collateral causes, which neither our analysis nor our reasonings are competenr to comprehend. The habits of life of this great mathematician were of the most simple and laborious kind; though he never missed a meeting of the Institute, or a lecture, or an examination, or any other public engagement, yet on all other occasions, at least in his later years, he denied access to all visitors, and remained in his study from an early hour in the morning until six o'clock at night, when he joined his family at dinner, and spent the evening in social converse. or in amusements of the lightest and least absorbing character, carefully avoiding every topic which might recall the severity of his morning occupations. The wear and tear, however, of a life devoted to such constant study, and the total neglect of exercise and healthy recreations, finally undermined his naturally vigorous constitution, and in the autumn of 1838 the alarming discovery was made that he was labouring under the fatal disease of water in the chest. The efforts of his physicians contributed for a long time to mitigate the more serious symptoms of his malady; but every relaxation of his sufferings led to the resumption of his labours; and to the earnest remonstrances of his friends, and the entreaties of his family, he was accustomed to reply, that to him *la vie c'était le travail*; nay, he even undertook to conduct the usual examinations of the Ecole Polytechnique, which occupied him for nearly ten hours a day for the greatest part of a month. This last imprudent effort ended in an attack of paralysis, attended by loss of memory and the rapid obscuration of all his faculties; he continued to struggle, amidst alternations of hope and despondency, for a considerable period, and died on the 25th of April last, in the 59th year of his age. Poisson was eminently a deductive philosopher, and one of the most illustrious of his class; his profound knowledge of the labours of his predecessors, his perfect command of analysis, and his extraordinary sagacity and tact in applying it, his clearness and precision in the enunciation of his problems, and the general elegance of form which pervaded his investigations, must long continue to give to his works that classical character, which has hitherto been almost exclusively appropriated to the productions of Lagrange, Laplace, and Euler. If he was inferior to Fourier or to Fresnel in the largeness and pregnancy of his philosophical views, he was incomparably superior to them in mathematical power; if some of his contemporaries rivalled or surpassed him in particular departments of his own favourite studies, he has left no one to equal him, either in France or in Europe at large, in the extent, variety, and intrinsic value of his labours. The last work on which he was engaged was a treatise on the theory of light, with particular reference to the recent researches of Cauchy; nearly two hundred pages of this work are printed, which are altogether confined to generalities, whose applications were destined to form the subject of a second and concluding section: those who are acquainted with the other works of Poisson will be best able to appreciate the irreparable loss which optical science has sustained in the non-completion of such a work from the hands of such a master.

DEVELOPMENT OF ELECTRICITY FROM HIGH PRESSURE STEAM.

On Saturday, the 19th December, Mr. Condie, manager of Blair Iron Works, Ayrshire, performed this new and interesting phenomenon at the above works, in the presence of Ludovic Houston, Esq., of Johnstone; —— Cunningham, Esq., of Carnbrae Iron Works; Thomas Wingate, Esq., engineer; Springfield, and a number of others, who were all highly satisfied with the accuracy of the accounts given by the public press of similar experiments having been made in the neighbourhood of Newcastle, upon locomotive engine boilers. The experiment made by Mr. Condie was upon the steam issuing from the safety valve of two of the high pressure boilers of the blowing engine, and was simply performed as follows:—

The experimenter placed himself upon an insulated stool (a board resting upon three quart bottles in absence of better,) and having in one hand a long small rod of iron, with four sharpened points, similar to a lightning conductor; this he held in the steam issuing from the safety valve. When the points were held about one foot from the valve, electric sparks were drawn by the bystanders' knuckles from those of the experimenter about half an inch long; but as the pointed rod was raised to about six or eight feet above the valve into the cloud of steam, vivid and pungent sparks were then drawn from one and a half inches long, which, in fact, were nearly as stunning upon

the arm as the shocks of a small Leyden phial, producing a good deal of merriment to the astonished workmen who were present, to see fire and feel the shocks from steam, an article they all supposed themselves perfectly familiar with.

In the evening the experiment was resumed, to see the effects in the dark, when they proved the experimenter to be highly charged with electricity. The board on which he stood, not being rounded, each corner had a brush of light two or three inches long, like as many tassels, while every point of his dress and hair became highly luminous upon the persons standing near him. On this trial, sparks were drawn fully two inches long, which required some little courage to engage with, from their shocking propensities.

The experiments were made upon the steam of two boilers, thirty-two feet long by six diameter, first with steam equal to 12 lb. upon the inch, and latterly at 25 lb.—the increase of pressure adding to the effect. However, the experiment was perfectly and satisfactorily performed with the surplus steam issuing from the safety-valve while the engine was going upon trial. Mr. Condie is of opinion that, from such boilers, with a properly constructed prime conductor, of large surface, sparks may be drawn from six to eight inches long, and large jars charged in a few seconds. The wonder was that the experiment succeeded at all, as the apparatus was altogether rude. The floor where the temporary stool stood was covered with dust, shavings, &c., which acted as conductors in stealing away the electricity from the experimenter.—*Ayr Observer*.

PUBLIC WORKS IN PARIS.

The *Moniteur* takes a survey of the principal public buildings in Paris and its immediate vicinity, either terminated during the past year, or the works of which have been much advanced. We gather from it the following particulars:—It appears that the interior of the new buildings added to the Luxemburg would have been entirely finished but for the interruptions caused by the political trials that have taken place before the Court of Peers. Several alterations have been made in the gardens, and the whole may now be expected to be speedily terminated. Statues or other decorative objects are to be placed on the pedestals of the Pont de la Concorde, to make it harmonize with the present highly decorated aspect of the Place de la Concorde. Nothing but works of ornamentation now remain to be done at the Madeleine. The paintings by Messrs. Abel de Pujol, Schnetz, and Signol have been uncovered in the interior, and the statues that are intended for the several altars are far advanced. The Abbey of St. Denis will still take two years before all the repairs are completely terminated. During the last year the great circular window in the north transept, and the organ-loft, have been finished. The works in the Palace on the Quai d'Orsay are not yet terminated, but the Court of Accounts is expected to move into that building during the spring. The works for new bureaux at the office of the Minister of the Interior, Rue de Grenelle, are rapidly advancing: as are also those at the hotel of the Minister of Public Works, Rue St. Dominique. The archives of the law department are to be removed from the Sainte Chapelle to the new buildings at the Hôtel de Soubise, Rue du Chaume, preparatory to the restoration of the former edifice. An amphitheatre for lectures has been erected at the Observatory, and several buildings have been made at the Veterinary School of Alfort, for giving better accommodation to the professors for their lecture, &c. The buildings of the new Blind Hospital, Boulevard des Invalides, will shortly be entirely roofed in; and the additional erections at the Lunatic Asylum at Charenton are going on rapidly. Numerous public buildings, such as the Bibliothéque Royale, the Bibliothéque St. Geneviève, and the Conservatoire des Arts et Metiers, are in such a dilapidated state, that the Chambers will no doubt vote the funds requisite for repairing them, or erecting new ones.

NEW INVENTIONS AND IMPROVEMENTS.

PAPYROGRAPHY.

This is a new invention for reproducing drawings, manuscripts, and all kinds of designs to an unlimited extent, and by means much cheaper than at present known. This process, which is called by M. de Manne, the inventor, *Papyrography*, is very fully noticed in a late number of the *Moniteur*, from which we abridge the following particulars.—The mode by which M. de Manne produces designs, &c., on paper, is thus described. After having, by means of his prepared metallic ink, traced the drawing on common writing paper, he contrives, by an operation which he at present keeps secret, to make the lines rise from the paper in relief, and become extremely hard and durable. He fixes this matrix on a plate of metal, on which he then places the paper that is to receive the impression. Over the paper he places a piece of silk, and passes it under the roller of a copper-plate press; when the characters and lines on the manuscript or drawing are reproduced, stamped in on the paper. These designs thus fixed on the plates are hard enough to allow of a greater number of impressions being taken without injury to them. The part of the invention, which consists in obtaining plates of metal cast from the matrix afforded by the drawing on the paper, is considered by the committee of the Society of Arts of Mulhausen, who were appointed to examine it, as of still greater importance than any other. By this engraving on paper, say the committee, may be obtained impressions fully equal to what can be had from wood engravings; by this means, therefore, works which require illustrations may be printed with great cheapness. In engravings on wood, the design and the subsequent cutting are necessary, but by the papyrographic method, the design is the only expense; and it will produce without end as many engraved plates and impressions as may be required, at a cost one half of that of the ordinary process; and with a precision equal to that of the original drawing.—As M. de Manne conducted his experiments at Rouen, where there was no skilful metal founders, he laboured under great disadvantage in his attempts to bring his invention to perfection, but the specimens he sent to the committee were sufficient to convince them that his plan was capable of answering all that he stated. Some of the specimens sent to the committee presented the designs, and the printed copies from them in relief to the height of from two to three millimetres, obtained solely from the matrix traced on paper. The committee propose to extend the invention to the printing of woven fabrics and paper. M. de Manne sent some plates prepared for this object, but owing to the disadvantages under which he laboured, the plates were not so perfectly cast as they ought to have been, to produce the desired effect. The defect, however, he ascribes entirely to the unskilful manner in which the Rouen founders took the cast of his matrices; for not venturing to trust them with the paper moulds, he took casts of them in plaster; from which the metal plates were afterwards cast. It is to this circumstance that M. de Manne attributes the failure of his experiment, as it was difficult to take the cast in plaster from the paper so as to preserve the sharpness of the outline. He says he is certain of the success of his process as applied to the printing of papers and calicoes, but want of means with him, as with many other inventors, prevents him from taking out patents, or from carrying the invention into operation. The committee report that it seems to them highly probable that if the inventor was placed in more favourable circumstances, he would arrive at remarkable and very useful results. In conclusion they recommend the society to grant him a silver medal, though the invention is not of a nature within their usual subjects for prizes.—*Inventors' Advocate*.

BRICKS AND TILES MADE BY MACHINERY.

The French Academy of Sciences lately appointed a committee to examine a machine for making bricks, invented by M. Carville. The following is the substance of their report.—The committee proceeded to examine the action of the machinery in reference to its three principal functions,—of mixing the materials, of moulding the bricks, and afterwards of extracting them from the moulds. The mixing of the clay is performed in a vertical cylinder, by means of an iron axle, to which arms are fixed at different heights, which are furnished with knives. A rotary motion is given to the axle, by the power of a horse, applied to the end of a long lever. The materials are thrown in at the upper end of the cylinder, and when properly mixed, are passed into the moulds, through an opening in the side towards the bottom. Inclined boards, in the form of the sails of a wind-mill, are connected at the lower end of the vertical axle. The pressure resulting from the inclination of these boards constantly pressing against the clay during their rotatory motion, forces it out of the opening; a small vane, formed of iron plates, regulates and restricts the manner in which it issues out. An endless chain, composed of moulds of cast iron, joined to each other by hinges, passes under the base of the cylinder, and the moulds are thus filled with the prepared clay. A heavy roller, of cast iron, begins the compression; it is finished by drawing the loaded moulds through a compressor, composed of two plates of iron, the surfaces of which are not quite parallel. The removal of the bricks from the moulds takes place immediately after the compression, by means of a rammer acting from above. By causing the rammer, during the process, to move in the same direction as the chain of moulds, a continuous action is obtained, by means of very simple mechanism. The moment when the blow of the rammer should be given is very ingeniously determined, by joints fastened to the moulds. This motion, thus derived from the chain of moulds, and acting invariably with it, prevents the inconveniences that would result from the lengthening of the chain, by the inevitable wearing out of the hinges. The adhesion of the earth to the sides of the moulds, is avoided by their being immersed, for half a revolution of the cylinder, in water, with which a vessel placed under the machine is filled.—Two hoppers are introduced in the machinery, before and after the reservoir, where the earth is prepared. They spread in the requisite quantities the fine sand with which they are constantly supplied. One of them spreads the sand before the moulds are filled, upon plates of iron, connected together so as to form an endless chain, which serves as the bottoms for the moulds. The other hopper sprinkles the surface of the bricks before compression. Thus any adhesion of the substance continues to be avoided both with the roller with which the compression begins, with the iron work which completes it, and with the rammer which removes the clay from the mould. For greater precaution, and in order to obtain more regular surfaces, a slight stream of water continually moistens the pressing roller. The bricks are received on an endless chain of iron plates, after they are taken from the mould, by which they are conveyed to the kiln. The power of a single horse, by turning a wheel, prepares and moulds about 1,500 bricks in an hour.—The commissioners, on concluding their report, observed, that they had convinced themselves of the complete mixture of the substances forming the bricks, by breaking and inspecting several of them. They inspected the

whole process, and so far as the result of the manufacture was concerned, they express themselves perfectly satisfied. As to the saving to be effected by it, they had no ground on which to arrive at a satisfactory conclusion, so as to confirm the statement of the inventor, who affirms, that for the cost of two francs he can mould a thousand bricks. From their inspection of the working of the engine, they were enabled to think that this statement is correct.—*Ibid.*

NAIL, PIN, AND RIVET MACHINERY.

William Southwood Stocker, of Birmingham, certain improvements in machinery applicable to making nails, pins, and rivets, Jan. 2. Claim first.—Mode of combining the forging tools in a moveable frame, and causing such tools to approach each other and forge a bar of iron that is properly held by a machine, either in making the stems of nails or bolts, or in pointing their ends. Claim second.—Mode of constructing the heading and cutting machine. Claim third.—Mode of applying moveable dies to the machine, for heading pins and rivets. Claim fourth.—The turning over by machinery and cutting a series of plates or strips of metal in making cut nails. A crank axle is mounted in a strong frame communicating by means of pulleys to the engine. Four iron bars are caused to slide backwards and forwards in a frame by a rod from the crank axle. Other sliding bars are placed so as to move in a position at right angles to these. Their ends are supplied with anti-friction rollers, that work against an inclined plane. By these bars the forging tools are moved to their proper places. A tube extends along the machine, one end of which very nearly approaches the forging tools. A red hot bar of iron is passed through the tube: motion is given to the axle, which, through the connecting rod, gives motion to the sliding bars and rollers, causing the forging tools to close together, and their action on the heated bar produces the shanks of bolts, nails, or rivets, of any shape or size. The heading machines are constructed by a cranked axle, working the heading die, which strikes the bolt as it lies in a proper cavity, and forms the head of the nail or rivet. Another machine is shown in which the working parts are the same, only instead of a fixed cavity for holding the shanks previous to the heading, dies are used, one of which is moveable and the other fixed, and are held together by a spring catch and lever. With reference to the last part of these improvements: a pair of shears are worked by the revolution of a crank axle. At the face of these shears a series of cylinders are placed angularly. Through the end of each a strip of metal of the required width passes. The whole of the cylinders are connected by pinions and a rack, so that on the cranked axle being made to revolve, a nail is cut from each strip of metal by a descending cutter. A sliding motion is then given to the rack, which causes the cylinders and pieces of metal to move round sufficiently at every stroke of the cutter, to preserve the angular or taper form of the nails or brads.—*Ibid.*

SUBMARINE PROPELLERS.

John Edward Carpenter, of Toft Monks, Norfolk, improvements in the application of machinery for assisting vessels in performing certain evolutionr upon the water, especially tacking, veering, propelling, steering, casting or winding, and backing astern, Dec. 12. Claim first.—The application os adaptation of submarine propellers, as hereafter described, in whatever situation such propellers may be placed. Claim second.—The peculiar form of the propellers, shown in the drawings annexed to this specification. These improvements may be divided into three parts:—First—The method in which the propelling apparatus is fixed, for propelling vessels at the greatest possible speed attainable, with reference to submarine rotary propellers on the quarter. Secondly—The method of applying the same apparatus, so as to turn vessels about without the assistance of wind or rudder. Thirdly—The method of applying the apparatus to vessels, with one propeller at the stern. The blades and screws forming the quarter propeller may be constructed either of metal or wood, their strength and superficies depending on the size of the vessel which they will have to propel. Spindles are constructed, which consist of moveable axles protruding through the vessel at both quarters, near the line of floatation, below the load-water line and above the keel, between the midship section and the stern frame. These spindles are enclosed by metallic cylinders, or other proper packing, having a cup and socket valve and stuffing-box at one, or both, ends, and are firmly secured to the timbers of the vessel. That part of the spindle which is within the vessel is to be connected to a steam-engine, or other first mover, by any convenient mechanical contrivance. The outer part is connected to the propelling shaft. The regulator consists of a rod furnished with a rack and pinion, with a pendant bearing attached to the propelling shaft at the bottom of the rod. Through this bearing the propeller shaft passes, by which means the propeller can be raised or lowered, as circumstances may require. The end or stern bearing is constructed of metal and bolted firmly into the transom of the vessel, so as to be capable of resisting the force of heavy seas against the propeller, and also of being easily detached. With reference to the second part of these improvements, a bevelled wheel is fitted upon the capstan, and this communicates the motive power to the propellers; there are two pinions which gear with the bevelled wheel. The axle of the pinions are connected with the spindles as above described. The propeller is confined in its position by a stay and other parts of the apparatus. The shaft rotates in a bearing, and can be raised or lowered by means of a topping lift. After the apparatus has been connected with the capstan, it is only necessary to turn that by power, and the head of the vessel will move round. The third part of this invention consists in the manner in which the rudder is divided, so as to admit the shaft of a single propeller to pass through it, and also in the form of the blades to be applied to such shaft. The length of each blade is more than twice its radius, and two of these blades are placed angularly upon the shaft, which is supported by a hinged bearing at its extremity, a strong iron connecting piece joining the rudder at its upper and lower divisions.—*Ibid.*

PLASTER CASTING.

Plaster of Paris is sulphate of lime, or gypsum, deprived of its water of crystallisation by heat. In this state it has such an affinity for water, and is capable of taking up so much, that when the powder is mixed with water till it becomes of the consistence of cream, it sets after a few seconds into a hard mass. In the manufacture of plaster casts, we must pay attention to several little niceties, in order to get rid of all the air bubbles. These arise from two causes, either from the adhesion of the air to the plaster, or from the plaster carrying down air with it, when added to the water. The first is to be remedied by using fresh burnt plaster, which is always adopted by the cunning stereotypers, for they state that if it simply stands a fortnight, the casts will not be so good. The workman cannot explain this, but the rationale was well known to Mr. Wyatt, our celebrated sculptor, who told me that he attributed it to the adhesion of the air; and that thus many delicate casts were injured. He places the common plaster in a saucepan over the fire, and heats it, when it heaves from the discharge of gas, and is then ready for use. Sufficient plaster should be placed in a basin, and water poured upon it till it is completely covered, and all bubbles cease to rise, when it must be thoroughly mixed by rubbing it together. The surface to which it is to be applied should be slightly brushed over with a very small quantity of salad oil. A little fluid plaster may then be poured on the cast, and with a hog's bristle painting brush thoroughly rubbed into all the fine parts, which will prevent the adhesion of any air bubbles in the plaster which might prevent a perfect impression. Another portion of plaster, sufficient to give the desired thickness is now to be added, and time must be given for the whole to set, when it should be removed from the mould, and gently heated to drive off excess of moisture.—*Smee's Elements of Electro Metallurgy.*

PRESERVATION AND STAINING OF WOOD.

M. Boucherie's process, which we have already noticed, proposes to render wood much more durable, to preserve its elasticity, to prevent it from undergoing variations in volume, to which it is liable by dryness and humidity, to diminish its combustibility, to increase its tenacity and hardness, and to give it varied and durable odours and colours. The mode is, to cut the tree at the bottom when it is growing luxuriantly and full of sap. The lower part is then immersed in a trough containing the liquid which it is intended shall penetrate the vessels of the tree. This will reach the highest leaves in a few days. It is not necessary that the tree should be supplied with all its branches and leaves: a few leaves at the summit will suffice. It is not, however, necessary to cut the tree: a niche at the bottom will answer the same purpose, by which the liquid may be introduced. 1. To increase the *hardness* of the wood, and to preserve it from decay, a solution of pyrolignite of iron is to be employed, a substance readily formed by digesting iron filings in pyroligneous acid. 2. To diminish the combustibility, M. Boucherie introduces chloride of lime, or the mother liquor of salt marshes; the wood is thus rendered more flexible. 3. The author also stains the most common natural and indigenous woods. With pyrolignite of iron, a brown colour is produced; with tannin, an inky colour is formed; Prussian blue and yellow tints are afforded by introducing these substances with prussiate of potash, acetate of lead, and chromate of potash. This paper has been very favourably reported on by Dumas, Arago, &c.

FIRE PROOF BUILDINGS.

Louis Lecomte, of Leicester Square, gentleman, for constructing fire-proof buildings. Jan. 9, 1841. This plan consists in the employment of iron frames to receive concrete matters for forming the walls. The basement story of the building is constructed according to the ordinary methods up to one foot or more above the ground; on the basement so constructed is to be erected the patent wall, formed of frames entirely of cast iron, in one or more pieces, or a combination of cast iron and wrought iron plates. These frames are to be set one on to the other until the required height is obtained, the necessary stability being obtained by means of steady pins at the corners of one frame fitting into holes made in the corners of the frame which is opposed to it. Suitable shaped frames are employed for the internal partition walls, and for doorways, window frames, &c. The flues of the chimneys are

formed of iron or other metal pipes, placed in the thickness of the walls. When the required elevation is obtained, a concrete of any suitable materials is poured into the framing, and fills up the vacant space, giving firmness and solidity to the structure; a concrete of gravel and lime is preferred. To give steadiness, lead is to be introduced between the joinings of the iron work, in the manner well understood by workers in iron. The doors and window frames are to be fastened to the walls by any of the usual known methods. The main beams and cross beams of floors and roofs may be of cast iron, or formed of iron and wood; or they may be formed of one or more pieces of plate iron, bent up into an oval form, and straightened by an iron or wooden bar passing through them lengthwise, the upper edges of the metal being turned over to increase the strength. In the interval between the beams there are to be iron rods running in various directions, and supporting a metallic wire work, which forms the foundation of the ceiling. Similar wire work is to be employed in lieu of laths for all plaster surfaces. The claim is —1. The mode of constructing the walls of buildings by applying frames of iron filled with concrete. 2. The mode of constructing beams of bent plates of iron. 3. The mode of forming ceilings and other plaster surfaces by the application of wire work in place of laths.—*Mechanics' Magazine*.—[The last claim was adopted in the building of the Pantechnicon, near Belgrave-square. —Ed. C. E. and A. Journal.]

RAILWAY CONFERENCE.

On Tuesday, 19th ult., a general meeting of railway directors and managers was held by appointment at the large room in the Queen's Hotel, Birmingham, at which were present delegates from the following companies, namely:—Birmingham and Derby, Birmingham and Gloucester, Chester and Birkenhead, Eastern Counties, Great Western, Hull and Selby, Lancaster and Preston, Liverpool and Manchester, London and Croydon, London and Greenwich, London and Birmingham, London and Brighton, London and South-western, Manchester, Bolton, and Bury, Manchester and Leeds, Midland Counties, North Midland, North Union, York and North Midland.—George Carr Glyn, Esq., was called to the Chair, and a lengthened discussion took place upon the objects of the meeting. The following is a copy of the resolutions, which were unanimously adopted:—

1.—That in consequence of the public anxiety occasioned by the accidents which have taken place on various railways, the companies here represented, in order to profit by the combined experience of the principal lines, have deemed it expedient that a general conference should be held, for the purpose of taking into consideration the causes and circumstances of such accidents, and the means that may be available of more effectually guarding against their occurrence for the future.

2.—That this meeting acknowledges the grave responsibility which attaches to railway directors, and the obligation under which they lie, to adopt all judicious and practicable expedients for ensuring the general accommodation, comfort, and safety of the passengers entrusted to their charge. That under a strong impression of this responsibility they have assembled on this occasion, and have pursued their deliberations at the present conference.

3.—That this meeting, while it deeply regrets the accidents which have occurred, looks forward with confidence to the beneficial result of unremitting vigilance and habitual caution steadily enforced and established, as the great means of safety to railway conveyance, and accordingly would deprecate any sudden or hasty legislation on the subject; being convinced that the means referred to, aided by such improved arrangements and mechanical adaptations as a more matured experience may suggest, will amply accomplish the desired object.

4.—That the moral character and general fitness of enginemen and firemen, as well as of policemen and other servants, in the correct performance of whose duties the public safety is involved, are so essential to the security of railway travelling, that this meeting recommends to all railway companies the strictest examination into these points; and that it should be a rule more generally adopted amongst different managements, not to employ servants having worked on other lines, without authentic and satisfactory testimonials from their former employers.

5.—That in case of serious neglect of duty on the part of railway servants, it is desirable more frequently to put in force the penal provisions of Lord Seymour's Act, in order that the strictest discipline may be maintained; at the same time this meeting considers it due to men whose services are so arduous, to encourage the requisite discipline and obedience of orders, by adequate remuneration, and by suitable rewards for extraordinary exertions or long sustained good conduct.

6.—That the directors at this meeting assembled have taken into their serious consideration the expediency of placing on the engine a third man as conductor or captain, in addition to the engineman and fireman usually employed; and they are of opinion that such a measure, by distracting attention, dividing authority, and removing or diminishing the responsibility of the enginemen, would increase rather than lessen the risk of accidents to the trains.

7.—That this meeting considers it desirable that there should be a uniform system of regulations and signals recognised as applicable to all railways; and they recommend that the following rules and regulations, with this view, be submitted to the consideration of each railway company.

The following is the code of signals recommended:

Signals by Night.

The *white light* stationary, indicates that all is right; but if waved *up and down*, is a signal to stop; if waved *to and fro*, sideways, to proceed cautiously.

The *red light* is a signal always to stop.

By Day.

The *red flag* is the signal to stop.

The *blue flag* is to stop second class coach trains, luggage, or picking up trains, for the purpose of sending on wagons.

The *black flag* is used by plate layers to indicate that the road is undergoing repair, and that trains must pass slowly.

It is to be understood that *any* flag or lamp, of whatever colour, *violently waved*, is a signal to stop.

[We think it is a great pity that such a great assembly should have taken place to produce such a trifling result. Parturiunt montes, nascitur ridiculus mus. It does appear to us that the directors might have been better employed, or have brought out a more efficient code. The whole affair is quite in the British Association style.—Editor.]

ROYAL POLYTECHNIC INSTITUTION.

We promised ourselves and our readers, last month, a more extensive account of this valuable institution, which we shall now endeavour to give— although, probably, it will be a work of supererogation, as so many of our readers must be either contributors to it, or visitors. The building itself we have sufficiently described on a former occasion, when we gave a plan and engravings of it, so that it now only remains for us to notice some of the many attractions in the exhibition. Going into the Hall of Manufactures, we find a four-horse power double-cylinder condensing engine, by Humphrys, of Lambeth. Entering the gallery of the Great Hall, we meet with one of the first of a series of artistical exhibitions; here you may have your profile taken, go to another artist, and for a trifling fee he models your likeness, this you may have electrotyped, engraved on copper, or lithographed, all in the same establishment. The assemblage of models of planets, on a scale of an eighth of an inch to a mile, is an epitome of the wonders of creation well calculated to suggest serious meditation; the little globe on which we live is dwindled to the proportions of a child's taw, and yet, to place these planets in their due positions, would take a space of seven miles diameter. Long's engine-turning on glass presents old specimens of a standard favourite. Close along side are some of Crace's works in papier maché. In the case marked B are some truly valuable examples from the factory of Mr. Apsley Pellatt, of the progress we have made in the manufacture of glass. We wish we could particularize some of the well-executed ornaments from the Elgin marbles and other antiques. The chess table, painted on slate, in imitation of various marbles, is a very good proof of the skill of the artist, and of the value of the material as a ground for decoration. In case F are some of Mr. Reid's engines. In a side room is a great variety of vases and other works of art, and objects of utility, from the Royal Swedish Porphyry Works at Elfdal, in Sweden. There is only one objection we see to the general use of this stone, and that is the dearness of the articles, which, although they are of everlasting durability, tells upon the pocket. A little encouragement, however, and the proprietors will find means of reducing their prices. Here we may mention the many fine specimens of stained glass by several artists, and of flower painting by Madam Comolera. Now we have spoken of painting on glass, a reviving art, we must call attention to the specimens of wood carving exhibited, which will serve to show that we only want encouragement to revive this also—one by a boy of 9 (No. 438), is promising. Sir George Cayley, with the intention, probably, of competing with Cinderella's Crispin, has deposited, in case H, a pair of slippers, the uppers (we were going to write upper-leathers) composed of glass—these were doubtless the true Cinderella shoon. Elsewhere are some other good specimens of glass weaving. No. 531, &c., are 72 specimens of earths taken in boring a well 220 feet deep at Colebrook Cottage, Islington, showing the difference of the strata at every foot after the first hundred, which were principally blue clay. Osler's anemometer is an ingenious machine, but we should not think works favourably in its present position, as the registering apparatus must be interfered with by the elasticity of the floor, and the moving about of the company. In the lower part of the Great Hall are a number of engines and models, of which it is next to impossible, in our cramped space, to give any account. We must say the same of those relating to marine engineering. In the North-West Sky-light Room is a splendid mosaic table of Swedish porphyry, consisting of nearly 10,000 pieces, and of great weight; the price asked is, we believe, 3000 guineas. Going behind the Great Hall we get into a labyrinth of darkened passages, from which are views of a number of dioramic subjects, among which we must particularly call attention to the Typorama, or model of the Undercliff, in the Isle of Wight. In the West Balcony Room is the porcelain Table des Marechaux, painted by Isabey; five thousand guineas is asked for it, and it is said to have cost twelve thousand, but we fear it will be long before the raffle is filled. Another gorgeous and costly affair is the escriban or cabinet of Margaret of Parma, in the East Balcony Room. Dispersed about are many fine works of art by Mr. Longbottom, and eminent artists.

The best idea we can give of the Polytechnic Institution, is to call it a bazaar of science; you have a number of separate exhibitions and collections thrown into one, you witness the exercise of several arts, you have the use of two lecture rooms, and from the gallery a band converts the halls into a promenade concert, and this morning and evening:—and so with this epitome we shall leave the Polytechnic and its crowded halls to the occupation of our readers.

ENGINES ON BOARD THE "GORGON" AND "CYCLOPS" STEAM FRIGATES.

Fig. 1.

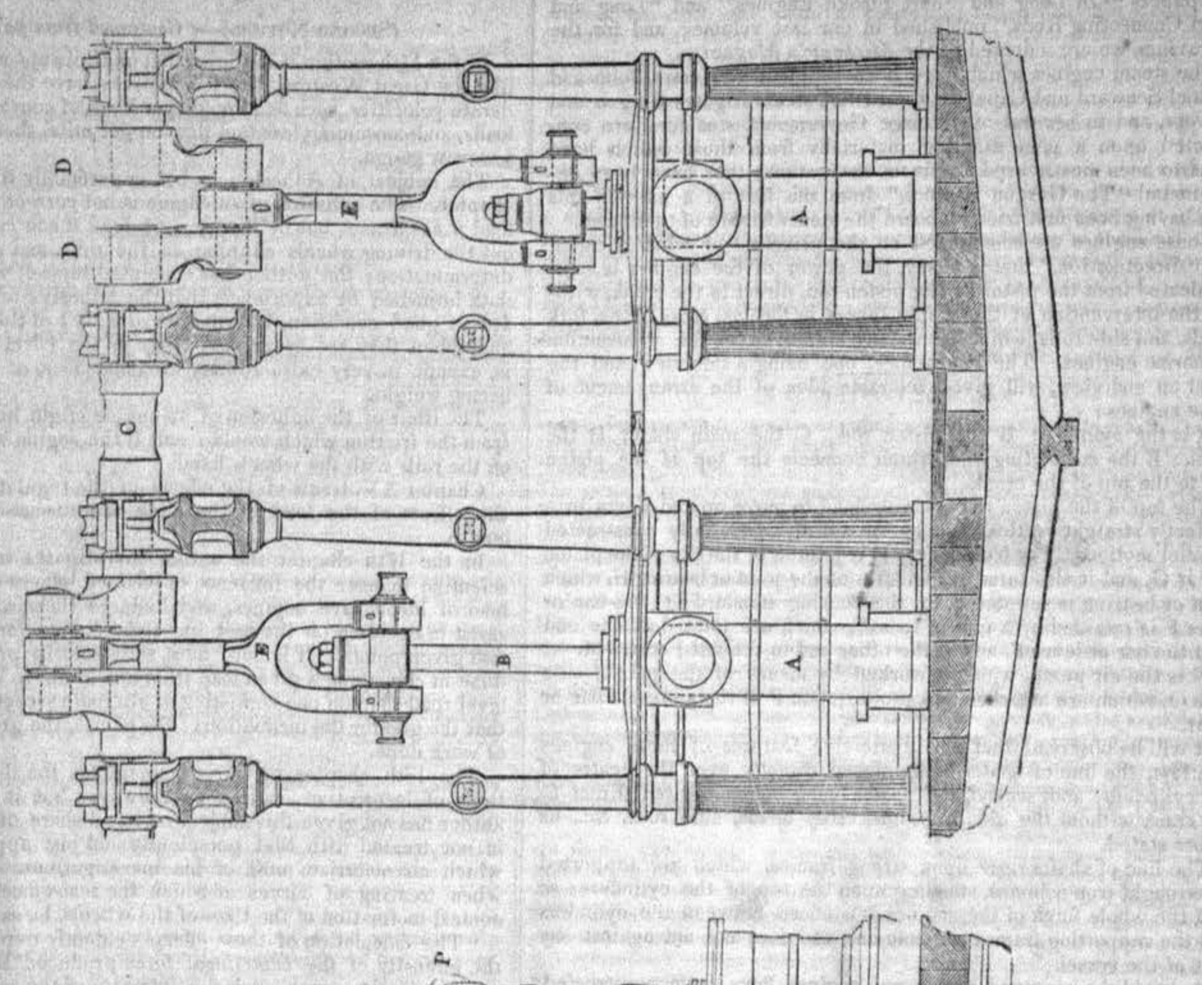
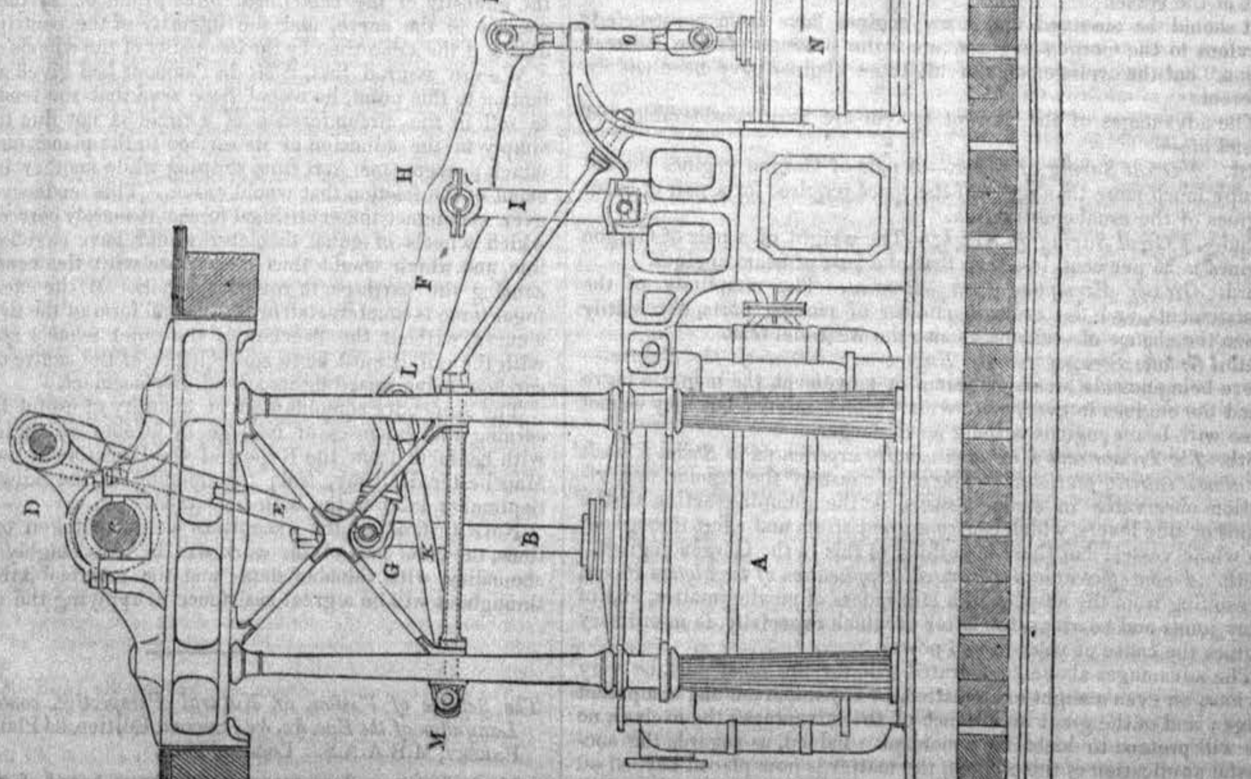


Fig. 2.



DESCRIPTION OF THE ENGINES ON BOARD THE "GORGON" AND "CYCLOPS" STEAM FRIGATES.

For the following description we are indebted to Mr. John Seaward's pamphlet, from which we have already quoted the two excellent papers "On Long and Short Stroke Engines," and "Long and Short Connecting Rods," published in our last volume; and for the engravings we are indebted to the *Mechanic's Magazine.*

The steam engines which have been supplied by Messrs. John and Samuel Seaward and Capel to the British steam frigates *Gorgon* and *Cyclops*, and to several other large Government steamers, are constructed upon a plan differing materially from those which have hitherto been mostly used in steam navigation; they have been denominated "The Gorgon Engines," from the fact of a pair on this plan having been first tried on board the steam frigate of that name.

These engines are constructed on the principle of what is called the "direct action," that is to say, the power of the engines is communicated from the piston by the piston rod, direct to the crank, without the intervention of those side levers or beams, cross heads, fork heads, and side rods, which are usually employed in the construction of marine engines. The engravings, one being a side view, and the other an end view, will give a tolerable idea of the arrangement of these engines:

A is the cylinder; B the piston rod; C the main shaft; D the crank; E the connecting rod, which connects the top of the piston rod to the pin of the crank.

The top of the piston rod is constrained to move up and down in a perfectly straight vertical line, by the aid of a peculiarly constructed parallel motion. The bar or lever F is jointed to the cap of the piston rod at G, and it also turns or oscillates on the joint or bearing H, which joint or bearing is supported by the rocking standard I; the bar or lever F is retained by a pair of rods K, which are jointed at one end L to the bar or lever F, and at the other end to the fixed centre M.

N is the air pump, which is worked by means of the pair of side rods O, which are attached to a prolongation P of the aforesaid bar or lever.

It will be observed that the distinctive features of these engines are, first, the line of shafts being placed directly over the centre of the cylinders; and, second, the power being communicated direct to the crank without the aid of beams, cross heads, side rods, &c., as before stated.

The line of shafts rests upon strong frames, which are supported by wrought iron columns, standing upon the top of the cylinders; so that the whole force of the engines is confined between the cylinders and the supporting frames and columns, and does not act against any part of the vessel.

It should be observed that many engines have been constructed, previous to the Gorgon engines, upon the principle of the "direct action," but the arrangements of all those engines have been widely different.

The advantages of the present system are very considerable, and consist of:—

1st. *A Great Saving of Space.*—A pair of Gorgon engines do not occupy much more than one half the space required for a pair of beam engines of the usual construction.

2nd. *A Great Saving of Weight.*—The weight of a pair of Gorgon engines is 25 per cent. less than that of a pair of beam engines.

3rd. *Greater Exemption from Accident.*—The simplicity of the arrangements, and the reduced number of moving parts, necessarily lessen the chance of accident, as also the wear and tear.

4th. *Greater Security for the Engine-men who work the Engine.*—There being no side levers or beams in movement, the men can move round the engines in every part with perfect safety; but they cannot do so with beam engines without much danger.

5th. *The Tremor and Vibration usually experienced in Steam Vessels are almost entirely prevented.*—The chief cause of the tremor and vibration observable in steam vessels, is the pumping action of the beams or side levers, which causes a great strain and effort throughout the whole vessel; but there is nothing of this in the Gorgon engines.

6th. *A more efficient and economical Application of the Motive Power,*—resulting from the absence of a large mass of moving matter, and of many joints and bearings, the latter of which especially, is in ordinary engines the cause of *much* loss of power.

The advantages above enumerated will, for the most part, be very obvious, on even a slight examination, by any impartial and competent judge; and of the great importance of the advantages themselves, no one will pretend to doubt for a moment. Indeed, as regards the successful application of this system, the matter is now placed beyond all dispute, as the trials of it, made in the *Gorgon, Cyclops*, and several other vessels, during the last three years, have been most satisfactory and conclusive.

REVIEWS.

Pambour on Locomotive Engines. London: John Weale, 1840.

(Second Notice.)—*(Continued from page 16.)*

In the 11th section it is shewn that on Railways with a wide gauge, like the Great Western, the locomotives have the advantage, at moderate velocities, such as 25 miles per hour, of conveying much greater loads, and consuming less fuel per ton per mile, than on railways with a narrow gauge.

The subject of Adhesion is but superficially treated in the 14th chapter. The adhesion of an engine is not correctly measured by the load *it has drawn*, but by the greatest load *it can possibly draw*, without the driving wheels slipping on the rails, and of this we have no determination; the author has contented himself with shewing, from data furnished by experience, that the adhesive force, when the rails are in good condition, is equal to *at least* $\frac{1}{6}$ of the adhering weight, and, when they are greasy and dirty by the effect of wet weather, it is, except in very extraordinary circumstances, *at least* $\frac{1}{17}$ of the adhering weight.

The limit of the adhesion of an engine might however be deduced from the friction which would result if the engine were dragged along on the rails with the wheels fixed.

Chapter XV. treats of the effects of the regulator, and in the 16th the effects of the lead of the slide are discussed at considerable length.

In the 17th chapter the author investigates in a very clear and scientific manner the influence of inclined planes on the velocity and load of locomotive engines, and deduces therefrom rules which may assist in deciding on the best line to be chosen for a railway between two given points. It is here most satisfactorily proved that the work done in conveying a given load from one point to another is less on a level road than on one consisting of alternate ascents and descents, and that the greater the inclination of the planes, the greater is the amount of work done.

The 18th chapter, on Curves, completes the theoretical considerations of locomotive engines on railways; but it is evident that the author has not given this subject an equal share of his attention, for it is not treated with that perspicuity and just application of science, which characterize most of his investigations. In the 2nd section, when treating of curves of which the resistance is corrected by the conical inclination of the tires of the wheels, he says, page 524,

"The calculation of these effects evidently depends on two things: the intensity of the centrifugal force produced by the motion of the wagons in the curve, and the intensity of the centripetal force produced at the same time by the inequality of the wheels of the wagons."

We are assured that, if M. de Pambour had given a little more attention to this point, he would have seen that the tendency of a cone to roll in the circumference of a circle is not due to any force, but simply to the adhesion of its surface to the planes on which it rolls, which prevents one part from slipping while another is rolling, on account of the friction that would ensue. This tendency does not, however, counteract the centrifugal force: it merely corrects the tendency which wheels of equal diameter would have to roll on in a straight line, and which would thus co-operate with the centrifugal force in causing the carriage to run off the rails. If the effect of the centrifugal force is counteracted by the conical form of the tires in traversing a curve, without the flanches of the outer wheels coming in contact with the rail, it must be in consequence of the centre of gravity of the carriage being raised by its lateral displacement.

The Appendix contains a great quantity of useful information concerning the expenses of haulage by locomotive engines on railways, with Extracts from the Report of the Directors of the Liverpool and Manchester Railway, from the opening of the railway, on the 16th September 1830, to the 30th June 1834.

Notwithstanding the exceptions we have taken to some few portions, the chief part of the work will be found highly instructive, and abounding with valuable data; and the practical tables interspersed throughout will be a great assistance in applying the various formulæ.

The Science of Vision, or Natural Perspective, containing the True Language of the Eye, &c. &c. Second Edition, 24 Plates. By Arthur Parsey, M.B.A.A.S. London, 1840.

Most of our readers, we presume, have heard of that kind of discovery which goes by the name of "finding a mare's nest;" and such it appears to us is that discovery in the laws of optics and perspective

on which Mr. Parsey so greatly prides himself; and of whose value he tries to convince us at first sight, by exhibiting a practical application of it in his own frontispiece. In one respect, indeed, that illustration has no novelty, for in nearly every work on perspective we are acquainted with, the subjects introduced as examples, are for the greater part either the most insipid or the ugliest things imaginable, nor does that piece of architecture,—which, by the by, was exhibited a season or two back at the Royal Academy, where it met with a good deal of quizzing,—form any exception to such general rule. It says so little for our discoverer's knowledge of, or taste in, architecture, that he would have acted more discreetly, had he contented himself with *Parseyfying* some building already provided to his hand; nor could he, perhaps, have selected a better subject to operate upon than the front of the Soanean Museum, that being a tolerably whimsical specimen of architecture in itself, and otherwise well fitted for the purpose, inasmuch as its height greatly exceeds its width, consequently it is much better suited to show the convergence of vertical lines, than Mr. P.'s own plump and squat structure.—At all events, as it is intended as a model sample of the new system of Perspective, or "New Language of the Eye,"—a language somewhat akin to Irving's Unknown Tongues,—it would not have been amiss had it been correctly drawn; so far from which being the case, there are hardly above two of the vertical lines that converge to the same point, but some of those that are nearest to the axis of vision are much more inclined than those which are farthest off! which produces the same effect as a drawing in which the cornice or upper horizontal lines of a building should be made to incline less than those of a string-course or lower cornice at half the distance or less, above the eye. It may be that this is an error merely of inadvertence, but then it is a most extraordinary instance of carelessness indeed, because Mr. Parsey must have been aware that his sample drawing would be likely to be rather rigourously scrutinized, and that any blunder in it would consequently be laid hold of as an objection to the system itself. Admitting for a moment his doctrine of the convergence of vertical lines to be correct, his notions of convergence must be exceedingly *eccentric*, for the upright lines of the little stumpy turret on the building vanish much more suddenly than any of the others, so as to give it, even when compared with the rest, the appearance of being a truncated pyramid. We do not know how drawings according to the *vulgar* and now to-be-exploded system of perspective, appear to Mr. Parsey's eyes, but most certainly the one he here favours us with, appears to ours a most preposterously distorted delineation, and totally contrary to nature.

Yes, we are so hopelessly obtuse that all Mr. Parsey's eloquence is quite thrown away upon us when he assures us "This effect of nature *launched incessantly upon the vision of mankind*, as well from *perpendicular* as from horizontal surfaces, has never been recognized by theorists, neither is it found in works of art. It has evidently been a sheer omission." "The necessity of adopting this principle for the future," he goes on to say, "in the visual sciences will require no urging so soon as this truth and its consequences shall dawn upon the unbiassed intelligence of the world."—Which last remark is exceeding well put in, for that dawn seems to be quite as far off as ever. Notwithstanding that so great a luminary as Parsey has risen upon the intellectual horizon, we are as much in the dark as before, or else obstinately shut our eyes and refuse to be enlightened by Parsey's sunbeams.

It certainly is most unaccountable that the very class of persons who are most interested in this notable discovery, and who must of all others be best qualified to appreciate its value, so far from gratefully bearing testimony to its importance—so far from availing themselves of it, are precisely those who set their faces against it, and protest against it with one accord, not indeed, loudly, but assuredly most significantly by refusing, one and all, to make any use of it. When we see one artist—one architectural painter or draftsman begin to adopt it,—when such people as Roberts, Nash, Haghe, &c., whose drawings are in all other respects so admirable, lay aside the old-fashioned, incorrect, vulgar system, and becoming enlightened begin to *parseyfy* their productions, then indeed our own obstinate prejudices may begin to thaw and melt away.

No doubt we are exceedingly dull: our comfort is that we are by no means singular in that respect; for not only have many others altogether scouted the "New Language of the Eye"—which they rudely set down as being All my Eye and Betty Martin,—but neither the Western, the Marylebone, the West London and the Westminster, Literary and Scientific Institutions, "from all of which societies," says Mr. P., "I received most satisfactory and complimentary testimonials," have done any thing as yet to promote and diffuse the new science. Their testimonials may be complimentary, yet if Mr. Parsey considers them *satisfactory*, all we can say is that he is the most reasonable and most easily satisfied person we ever met with. Were the case our own, we should set down the complimentary part of the business, as mere matter-of-course humbug, as being of just as much value as "Your very humble servant" at the end of a letter of refusal. If notwithstanding their professed admiration of the author's theory, people do not care to apply it practically, their testimony in its favour, however complimentarily expressed, must stand for just nothing at all.

With the Institute of Architects—whose testimonial in favour of his system would have greatly outweighed those of merely literary societies—Mr. Parsey was not quite so successful, being peremptorily repulsed, on offering to give "a full and gratuitous explanation" of it to that body. Not satisfied, however, with one repulse, he renewed his application about two years afterwards, when he met with no better success than on the former occasion; as he himself relates at length in his Introduction, where he has inserted the notes he received from the Secretary Mr. Donaldson, and animadverts upon the prejudice and inconsistency shown by the Institute in refusing him permission to demonstrate to them his theory. Yet although he evidently seems to have no suspicion of such being the case, the refusal on the part of the Institute, was probably prompted by kindness,—by unwillingness to let Mr. Parsey not so much explain his principles as expose himself; because the main point of all in his theory, namely, the convergence of vertical lines, must have been tolerably well known to most of the members, it having been made the subject of more than one article in Loudon's Architectural Magazine, where, in fact, it had occasioned some controversy. The Architects undoubtedly knew enough of it, to be aware that it would not at all hold water—as the saying is, and accordingly declined his offer; nor do we think that his frontispiece is likely to gain him any converts in that quarter. Mr. Parsey makes no secret of the repulses he has met with from others, for he speaks of "non-replies to letters addressed to influential scholars,"—we almost wonder he did not address himself at once either to the Premier or the Secretary for the Home Department;—yet although he quotes our friend Candidus, he does not attempt to controvert either what that writer or Kata Phusin have said, fatal as their objections appear to be to his theory, unless they can be set aside; whereas by allowing them to remain unanswered, Mr. Parsey leaves us to infer that he considers them unanswerable.

We have already given it as our opinion that the Frontispiece is not attractive,—otherwise than by its oddity; nor do we think that, its new fangled doctrine apart, the volume itself is calculated for any practical service. On the contrary, it appears to us that Parsey's new light serves only to mystify the subject more than ever—absolutely to bewilder it; and his processes of delineation to be most complex and tedious. To say the truth, there has always been a great deal more mystery made about Perspective, than there is any occasion for, that is, as far as practice alone is concerned, since for that merely a few simple elementary rules are required, and were they but properly explained and elucidated, they would be all-sufficient. The great point of all in teaching the practice of perspective is to convince the learner at the outset, not of its difficulty, but of its easiness, to explain the principles intelligibly, and not only intelligibly, but intelligently also, and to show how those simple elements suffice for all combinations, and for the most intricate subjects. But to come to Mr. Parsey's hobby, or rather his *cheval de guerre*, the Convergence of Perpendiculars—by which we are to understand Vertical lines, we will not be quite sure that Mr. Parsey clearly understands himself, or if he does he has most certainly an unlucky, Mrs. Malaprop way of explaining himself; for an instance clearly demonstrating the natural convergence of perpendiculars, he refers us to the effect produced by looking *up* from the bottom of a deep shaft, or *down* into a well! Good Mr. Parsey, this is playing upon people's credulity rather too openly, for you might just as well have told them not to look into a well nor to walk into one, but to go into the shaft of the Thames Tunnel, and fancy that instead of looking straight before them in a horizontal direction they were looking upwards. Such effects as looking upwards, whether to the roof of "a lofty cathedral" or a low room, cannot be represented except on a horizontal plane over the spectator's head, as in a painted ceiling, for it is only such prodigious artists as Billings who can show us at once the effect of looking up into the lantern in dome of St. Paul's, and down upon the pavement, at the same instant. Except in very particular cases, such as those of ceiling pieces, giving effects of *di sotto in su*, all pictures are supposed to be vertical planes, or planes perpendicular to the horizon, which we therefore view not by looking either *up* or *down*, but straightforward at, and in which no more can be properly represented than can be seen under such angle as will enable the eye to take in at one view the greatest diameter or dimension, whether it be that of height or breadth. And until Mr. Parsey undertook to enlighten the world, both we and all artists, have ever fancied that all lines *parallel* to the picture continued parallel to each other in repre-

sentation, no matter whether horizontal ones or vertical. Horizonta lines, indeed, generally converge, but then it is because they are situated *obliquely* to the picture; but that vertical lines can be so situated is utterly impossible, for then they would no longer be *perpendicular to the horizon*—that is no longer *upright* lines, but *sloping* ones. Consequently Mr. Parsey's doctrine either goes much too far, or else, does not go far enough. He is either much too daring, or much too timid, and fearful of following up his own principles consistently. He has nó objection to say A, but it goes against him to say B. Either he must now give up *in toto* his new law in regard to Perpendiculars, or extend it also to Horizontal lines *parallel* to the picture. There is no other alternative for him; and how so very keen-sighted a gentleman could possibly have make such a "sheer omission" in regard to the last is to us quite inexplicable; more particularly as he himself calls notice to his own oversight—to the unlucky flaw in his doctrine, by remarking that the same laws apply to and govern both Vertical and Horizontal lines, on the strength of which axiom he founds his doctrine in utter opposition to it, referring us to the visible vanishing or convergence of horizontal lines *inclined*, or situated *obliquely* to the picture, in order to convince us that lines perpendicular to the horizon, and therefore *parallel* to the picture plane, ought to converge similarly!! The fact is, Mr. Parsey has built up his fine theory on utter rottenness, and laid the foundation of his notable theory on a mere quicksand.

Here we were just going to lay down our pen, when the thought came across us that *Parseyism* or the new light in perspective, may easily be put to the test by any one, by merely applying it—as through "sheer omission," we suppose, Mr. P. himself has neglected to do—to an interior view of a building, for as the end facing the spectator would by the rules of *Parseyfication*, alias the convergence of perpendiculars, be narrower at top than at bottom, the consequence must be that the sides would *incline forward*. If after this, Parsey's is not allowed to be a complete Mare's Nest, we can only say that John Bull is more of a John Gull than we took him for, and that he deserves henceforth to resign his roast beef, and diet himself upon *moonshine*.

A Practical Detail of the Cotton Manufacture of the United States of America, and the State of the Cotton Manufacture of that country compared with that of Great Britain. By JAMES MONTGOMERY. Glasgow: John Niven, 1840.

Mr. Montgomery is known as the author of the Cotton Spinner's Manual, and the Theory and Practice of Cotton Spinning, both works of established and deserved reputation. The present volume is not less important either to the manufacturer, the mechanic, the economist, or the Englishman who regards the prosperity of his country as connected with its great staple article of export. In the United States we see the country which most threatens our supremacy—our main producer of the raw material, our victor in many foreign markets, and our still more dreaded rival as the introducer of factory slave labour. Under such circumstances, and with the threatening future staring us in the face, this volume before us comes with an equal interest to that which it would ensure from its own merits. Our satisfaction in perusing it has been great, but how to communicate by any extract an equal degree of interest to our readers has appeared to us a task of some difficulty, for it is not easy to detach such a portion of a work so connected as shall do justice to the subject, and at the same time it is, of course, out of our power to give any thing like a sketch which shall include the details of a subject so diversified. We must therefore content ourselves with noting down such remarks as we think may prove most interesting to our readers.

The plan of the Mills, says our author, is nearly the same in the different districts, none exceed five stories in height, except two at Dover (U.S.), which are six stories on one side and five on the other. The general height of the mills is three or four stories with an attic; but the mills recently built at Lowell are five stories high with a plain roof, from which he infers as probable that although the double roof has been the plan generally adopted, that it is likely to be abandoned, as it is the most expensive, and does not give so much room for machinery as the five stories and a plain roof. The mills are generally strong and durable. Instead of joists for supporting the floors, there are large beams about 14 inches by 12, extending quite across from side to side, having each end fastened to the side wall by a bolt and wall-plate; these beams are about five feet apart, and supported in the centre by wooden pillars, with a double floor above. The under floor consists of planks three inches thick; the upper floor of one inch board. Some have the planks dressed on the under side, others have them lathed and plastered; the floor being in all four inches thick, is very strong and lasting. The average thickness of the side walls may be from 20 to 24 inches, and they are generally built of bricks, there being very few stone walls, from the scarcity of freestone.

In England the factories have joists about three inches by ten; these are laid on their edges about 20 inches apart, with one inch flooring above, lathed and plastered beneath, or sheathed with thin boards. The joists are also supported in the centre by a beam about 11 inches by 6, running from end to end of the building; the pillars are of cast iron, and placed right under this beam, which does not rest on the pillar, but on a cast iron case which passes upon each side of the beam, and meets together above, by which means the uppermost floors are supported on columns of cast iron from the foundation; there is therefore no danger of such floors sinking in the centre. In the United States where the cross beams rest on the top of the pillars, while the pillars above rest again upon the beams, the floors in the upper stories sink down in the centre, in consequence of the shrinking of the timber, and the pressure of the ends of the pillars into the beams. Mr. Montgomery says, that he has seen some of these which had sunk down four or five inches in the course of four years.

The mills in England are from six to eight stories high, Stirling and Becktow's mill, Lower Moseley-street, Manchester, is nine stories. The general height of those in Scotland is six stories with a plain roof. In the United States there are few mills driven by high pressure steam engines; four in Newport, one in Providence, Rhode Island, and three in Newburyport, Massachusetts. The coals used whether anthracite or bituminous, cost from seven to eight dollars per ton (30s. to 34s.) In general the mills are moved by water; and in constructing them the water-wheels are necessarily put under cover, so as to be kept in an atmosphere, considerably above the freezing point in winter, otherwise the severity of the frost, which frequently descends to nearly 30 degrees below zero, would prevent them from operatiug a great part of the year; hence the water-wheels are generally placed in the basement story, which besides the wheels contains the mechanics' shop and cloth room, or sometimes it is filled in whole or in part with machinery. The English cotton factories generally have their picking or scutching rooms within the mill; but in the United States there are separate buildings erected for these purposes, generally standing like guardhouses about 20 or 30 feet from the main building, with the passages that connect them secured with iron doors, to prevent the communication of fire to the loose cotton in the picking house.

The method of communicating motion from the first moving power to the different departments in the English factories is by means of shafts and geared wheels; but in America it is done by large belts moving at a rapid speed; these are of the breadth of 9, 12, or 15 inches, according to the weight they have to drive, and pass through a space of from 2500 to 3600 feet per minute. A belt of 15 inches broad, moving at the rate of 3000 feet per minute, is considered capable of exerting a propelling force equal to 50 horses' power. All the most recent mills are belted, while many of the older ones have had the shafts and gears removed, and belts substituted in their stead; indeed belts are generally preferred even by those who have had sufficient experience of both. A belt of ordinary size would be between three and four hundred feet long, from twelve to fifteen inches broad, and would require from six to seven hundred pounds of good belt leather to make it. Such belts are always made from the centre of the back of the hide, to that they may stretch equally at both sides. Mr. Montgomery further remarks that however partial American manufacturers may be to this mode of conveying motion to the different departments, those who have been accustomed to the neat manner in which factories are geared in England must regard the above as heavy, clumsy, and inconvenient, as well as more expensive. As all these belts have to be enclosed, they occupy a considerable portion of the rooms they pass through; which, besides interrupting the view, gives less space for arranging the machinery. They are likewise very liable to stretch, and when too slack, they will slip on the drums; and owing to their breadth, it requires a considerable time to cut one joining and sew them up again. As to whether belts have more or less power than English gearing, Mr. Montgomery states his inability to decide satisfactorily; different opinions prevail in America, but there are two mills at Fall River, Rhode Island, which are said to decide the question in favour of the belts.

With regard to the arrangement of the machinery, diversities also prevail. In England the weaving is generally in the lower stories, and the carding and spinning above; but in the States, the weaving is contained in the upper stories, with the carding and spinning below.

Mr. Montgomery next goes on to describe the several classes of machinery used in the States, and to point out the differences from those of England, and here we shall endeavour as far as we can to follow him. The first class is the Willow, in connection with which he says that the American Picker is very injurious to the cotton, and

likely to be laid aside. The Willow Mr. Montgomery prefers is that called Mason's Willow, which he says is decidedly the best and occupies little room. In the English factories the Scutching and Spreading Machines are generally two separate machines, but across the Atlantic they are combined into one called the lap spreader, in which they have only one, two, or most three beaters or scutchers, while in England they have generally four or five. There are, says Mr. Montgomery, three most essential processes in the cotton manufacture which, in the factories of the United States are not so well attended to as in those of England. First, the cotton is not so well mixed; second, it is not so well cleaned; and third, it is not so well carded. With regard to the first our author is of opinion that by far too little room is allowed for the picking houses in the United States. Upon carding it is observed that few mills in the States use simple carding, mostly all have breakers and finishers, even those that manufacture the coarsest goods. The average speed of the cylinders there is about 100 to 110 revolutions per minute, there being no carding engines, driven at so high a speed as those in England, or which make work equal to those of the latter country. Indeed the English manufacturers generally make superior work with single carding to what the Americans do with double carding. The work before us says that it is the practice with them to crowd the cotton on to the cylinder so rapidly, that, instead of being taken away from the feeding rollers in single filaments, it is dragged in by the slow motion of the revolving cards in large flakes, which are not allowed to remain long enough under the operation of the tops, to be sufficiently teased out, the doffing cylinder being also driven too fast in proportion to the speed of the main cylinder. In England the practice is directly the reverse; the cotton is led into and delivered from the cards by a very slow motion; that is the motion of the feeding rollers and doffing cylinder, are comparatively slow in proportion to the speed of the main cylinder. For example, a main cylinder 36 inches in diameter will revolve between 70 and 80 times for one of the feeding rollers; in America their motions are as 35 of the former to one of the latter. The proportions of the revolutions of the main cylinder and doffer are in England as 25 of the former to one of the latter; in America as 17 to 1. The mode of stripping the cards adopted in the States is also inferior, as also that of grinding the cards. The drawing process is stated not to be so well performed, and to take twice the amount of labour across the Atlantic. The spinning warps Throstle Spinning Frames are universally used, except in some factories where very fine goods are made. They appear to be worked at a higher speed there, and with advantage, power being cheaper; Gore's Spindle which failed in Glasgow being most successful in the States. In weaving by power Mr. Montgomery considers that the Americans in every respect equal and in some things surpass any thing he has seen either at Manchester or Glasgow, particularly in common power weaving. In fancy weaving however they have not made a beginning. The spooling machine is cited as superior to that used in England, being much more simple, and capable of being attended by girls of 11, instead of women of 30. The warping machine is much the same as here; the dressing machines are entirely different, said to be more simple, more easily attended and kept in order, requiring less power and oil. The Power Looms are generally of improved construction.

We have we trust in this sketch shown enough of the merits of this work, to give a favourable idea of it to our readers, so that we shall conclude by congratulating Mr. Montgomery on this interesting contribution to the literature of a subject so important.

The Railways of Great Britain and Ireland. By FRANCIS WHISHAW, C.E. London: Simpkin and Marshall, 1840.

As we mean to pay several visits to this work, we shall for the present content ourselves with a few extracts, illustrative of the peculiarities of various lines, having in the meanwhile already said enough in our last notice to recommend it to the attention of our readers. Taking up the Aylesbury as the first subject, we find

This railway is laid to the English standard gauge, viz. 4 feet $8\frac{1}{2}$ inches. Although the land taken is wide enough for a double way, being about 17 yards, there is at present only one pair of rails laid down from end to end. It is one of the rare instances of a railway being constructed entirely without river, road, or other bridges, which is owing to its peculiar locality; but there are five level road-crossings, and three of these are highways, which are furnished with folding gates, each 9 feet long, shutting both across the railway and roads, according as they are required.

The station at Aylesbury is conveniently laid out: a triple way, connected, at a convenient distance from the offices, with the main line, runs into a railway-dock 33 feet wide at its entrance, and 12 feet at its connexion with the terminal turn-table, the side space of which is 4 feet 10 inches; the height of the quay, which has a curved batter of $2\frac{3}{8}$ inches, is 3 feet 4 inches; the quay on either side is about 10 feet in width. There is a carriage-dock 10 feet 8 inches in length, and 8 feet 10 inches wide, furnished at its entrance with a proper turn-table, and abutting on the yard, conveniently situate for the arrival of common-road vehicles; the arrival door for passengers is at the booking-office, on the left side of the railway as you approach Aylesbury; the departure-gate is on the right side: for the whole length of the station there is a siding for carriages when not in use.

The booking-office and general waiting-room are in one; there is, however, a separate room for ladies. This is, upon the whole, one of the best-arranged stations for a short line of railway that we have any where met with.

On the Ballochney,

There is a self-acting plane of 1200 yards in length on that portion of the line next the Monkland Railway; the lower part being a single way, the middle part double, and the upper part formed with three rails. The ascending train consists usually of four loaded wagons, and the descending train of six or seven empty wagons; the time occupied in the ascent is 3·50 minutes; the rope used is about $4\frac{1}{2}$ inches circumference; the sheaves are of 14 inches diameter, and are placed at intervals of 21 feet.

With regard to the Birmingham and Gloucester, Mr. Whishaw says,

The Lickey Incline of 1 in 37 extends for 2 miles 3·35 chains, and is, we understand, to be entirely worked by locomotive engines.

If this is satisfactorily effected, it will throw a new and useful light on the laying out of railways, and will save a vast original outlay in future works. We have long considered that the present system of making the sixteen feet gradient the *minimum*, is far from desirable. The advantages in working a railway thus graduated are not equivalent to the immense original outlay necessarily incurred by tunnels and overwhelming earthworks.

BRIDGES.—The whole number of bridges on this line is one hundred and sixty-two, besides one hundred and twenty-seven calverts. They are built of brick, of stone, of stone and iron, and some of wood. The span of arches over the railway is 23 feet; and the arches under the railway vary in span from 16 feet to 48 feet. The occupation-arches under the railway are each of 12 feet span.

There is a particular description of lattice-work wooden bridge used on this railway, which, we understand, was introduced from America by Mr. Hughes, the resident engineer; one of these we observed over a cutting near Bredon, which is about 117 feet in span, $17\frac{1}{2}$ feet wide in the clear, about the same height, and 200 feet in extreme length.

The roadway planking is supported by transverse joists about 6 feet below the top rail of framing. These joists are placed about 3 feet from centre to centre, and have a bearing on each side on the middle rail, or band, which runs from one abutment to the other. Besides this band, there are two superior and two inferior bands, running the whole length of the lattice-work. Each end of the framing has a bearing on cross sleepers bedded in the solid ground in proportion to the span, and is let into a pedestal at each end. Beneath the level of the roadway, the lattice-work framing on each side is connected together with cross ties and braces, both of wood.

In order to give this bridge a horizontal appeacance, the longitudinal timbers should have a slight camber. One of these structures, on our view of this railway, appeared to have sunk considerably in the middle.

The largest bridge is that which carries the railway over the river Avon, near Eckington. It consists of three cast-iron segmental arches, each of 73 feet span, and supported upon two lines of iron columns resting on iron caissons filled with masonry. The ribs and other castings of which this bridge is composed are not so sightly as they might have been; and the iron railing is of too studied a design for such a work. The whole length of this bridge is about 270 feet, and the clear width 23 feet. The total cost is stated to have been 10,000*l*.

It is a peculiar feature of this line, that although the rails are not laid throughout on longitudinal sleepers, there is an entire absence of stone blocks. This plan is gaining ground every day; and on some lines we have known sleepers substituted to a great extent for stone blocks, which had been originally introduced at great cost.

Of the travelling on the Brandling Junction our author seems to be by no means an admirer, for he says,

In consequence of opening this portion of the line at too early a period, the travelling over it was of the most extraordinary description we have experienced on any railway in the kingdom; for, besides the snail's pace at which the train proceeded, the motion of the carriages was precisely similar to that of a boat in a somewhat troubled sea.

It is an error, which most railway Companies have fallen into, to open their lines, or portions, before the embankments have sufficiently subsided to allow, if not of a safe, at any rate of an easy passage for the heavy trains made to pass over them. Some of the consequences of such hasty proceedings are to entail a large additional outlay on the proprietors, to bring discredit on the particular railway, and to give the now happily few enemies to the railway-system just cause for complaint.

A foot board on the carriages of the same line is more favourably noticed. The number of wagons seems large enough.

The second-class bodies, which are 14 feet 7 inches long, and 6 feet 2 inches wide, have also three compartments each, calculated to hold ten passengers. A footboard of wood, lined with plate-iron, runs along the whole length of the carriage on each side, and is of great convenience to the guards, who may thus safely walk along the side of the whole train when in motion.

There are nine goods-trucks, mounted each on Hawke's wheels.

There are upwards of 400 wagons at work on this line, built chiefly by Mr. Burnup, of Newcastle; but we were informed that the required number would be about 1500. The net weight of each wagon is about 44 cwt., and of size sufficient for 53 cwt. of coal. The wheels are of cast iron, 3 feet in diameter, and were generally furnished by Messrs. Hawkes and Co., of Gateshead. The cost of keeping a wagon in repair is estimated in this county at about 4*l.* per annum. The wagons are coated with tar—a practice which it would be very advisable for other railway companies to adopt.

With these few notes we must for the present leave Mr. Whishaw's work, observing that it contains a store of matter, from which we hope in our subsequent notices to extract, again impressing upon our readers the value of the present as a work of reference.

Gandy and Baud's Windsor Castle. Part II. London: Williams, 1841.

When Messrs. Gandy and Baud devoted themselves to the illustration of this national monument, they seem to have done so with a full determination to produce a work worthy the subject—a task which in this and the preceding number they have successfully carried out. The first of these fine plates presents us with a North West View of the Norman Gateway Towers and Queen Elizabeth's Building, a portion of the edifice in which two very dissimilar styles are placed in juxtaposition. This plate will we have no doubt be as great a favourite with the public as with the profession, for it unites great picturesqueness of effect with accuracy of delineation. Another work of the same class is the plate representing George the Fourth's Gateway and the York and Lancaster Towers, showing in the distance the Devil's Tower and the Great Round Tower. The elevation of Henry VII.'s and Queen Elizabeth's Gallery shows a range of building constructed under the several reigns of Henry 7th, Queen Elizabeth, Charles 2nd, Queen Anne, George 3rd and 4th, and William 4th, and made into one harmonious pile under the direction of Sir Jeffry Wyatville. Other plates in the work present a number of the details of the building, of great value to the student.

The promise held out by the publisher and conductors has been satisfactorily realized, so that we can have no hesitation in performing our duty of recommending most strongly this work to the patronage of the connoisseur, of the architect, of the student, and the public.

Excursions Daguerriennes. Part V. Paris.

We recommend this work to our readers. It comes out in numbers containing well executed engravings of scenes and buildings sketched by the Daguerréotype. In this publication the admirable capabilities of photography for architectural delineation is fully shown, and we have no doubt will prove extremely interesting. In this number are the Maison Carrée at Nismes, the Trajan column at Rome, the Church of Basil the Great at Moscow, and a view of the Mola at Naples.

A New Supplement to Euclid's Elements of Geometry. By the Author of a New Introduction to the Mathematics. London: Whittaker, 1840.

This is an ingenious work, by a well known author, propounding some new views, which will doubtless prove interesting to our mathematical readers.

Quarterly Railroad Journal, for January. Simpkin, Marshall & Co.

If no more railway bills pass, railway publications seem by no means afflicted with a similar sterility, for here we have before us a new contemporary. The *Quarterly Journal* contains several interesting papers on railway economy, emanating from one long experienced on the subject. Being devoted to the advocacy of the engineers against directors, it will doubtless be acceptable to many of our readers. We shall perhaps have occasion next month to advert to some of the views put forward, which will afford the best proof of the interest we take in this publication.

The Law and Practice of Letters Patent for Inventions: Statutes, Practical Forms, and Digest of Reported Cases. By Thomas Webster, Esq., of Lincoln's Inn, Special Pleader. London: Crofts and Blenkarn, 1841.

It is probably unfortunate for the author of this work that the nature of the subject upon which he treats is such as to prevent us from making extracts from it, such as would enable our readers to form an independent judgment upon it. They will perhaps however feel equal confidence when, without such testimonials, we refer them to Mr. Webster's book, as one which for clearness and completeness is much to be admired, whether as regards its application to this particular subject, or considered merely by a legal standard. The arrangement of the work is excellent, and the manner in which the information is epitomized not less so. Any one by a careful perusal of it, will be easily enabled to understand the rationale of a subject so important.

The Doctrine of Proportion clearly Developed, &c., or the Fifth Book of Euclid Simplified. By Oliver Byrne, &c. London: Williams, 1841.

"Censure on the works of others," says the author before us, "should be avoided as much as possible, because it shows the want of knowledge; those who know least, censure most: to correct a copy is easier than to produce an original; for men acquire criticism before ability, and it is mostly from those who possess no judgment that the most sweeping judgment comes." This is immediately followed by a general attack on Newton, Legendre, Simpson, Brewster, Professors Young and Leslie, Keith, Bonnycastle, Austin, Da Cunha, &c.

This is a very pretty brick from the work of Mr. Byrne, his book abounding with similar looseness and inconsistency. We will not quarrel with Mr. Byrne's definition of criticism, for he evidently does not know what it is, but at once dismiss him by observing that his book leaves the subject just where he found it, and that had he simply announced it as an edition of the Fifth Book with symbolical, arithmetical and algebraical expositions, we should have had less occasion for complaint at the nonfulfilment of his high sounding promises.

LITERARY NOTICES.

The fourth volume of the *Papers of the Corps of Royal Engineers* has been sent to us, but we have only time now to say that it appears to excel the character of its predecessors.

Another work published by Mr. Weale, *The Reports, Specifications and Estimates of Public Works in the United States of America*, must also be passed over for the present. It is a work of that magnitude and value that we should be doing injustice to it to attempt any cursory delineation of its contents.

ON THE COMBUSTION OF COAL.

Sir—With your permission I beg to offer some remarks on the review of my treatise "on the Combustion of Coal," inserted in the last number of your useful Miscellany. Commenting on a passage in my work, the reviewer observes, "is this a proof of the great value of coal as a heat-giving body? certainly not: it is the contrary; rather an evidence of the great quantity of heat expended in evolving the gas, which is no advantage, but very much the reverse." In my treatise I have strongly insisted on this point, as put by the reviewer, namely, the heat expended in evolving the gas, comparing it with the heat expended in converting ice into water, and water into steam. I fear however, the reviewer has overlooked the object I had in view, which was, not to shew, "the great value of coal gas as a heat-giving body," but as proof of the enormous quantity of it which coal contains, and the importance of turning it to account in the furnace.

The reviewer charges me with having made use of an improper term, and observes, that the expressions "bitumen, and bituminous portion" ought to be rejected, and, "gases and gaseous or volatile portion" substituted in their place. That the terms "bitumen," and "bituminous portion" are strictly speaking, not correct, is true, because, as Dr. Ure observes, "Coal contains no ready-formed bitumen, but merely its elements, carbon, hydrogen and oxygen." I beg however to observe, that the terms, "gases," and "gaseous portion" would not explain my meaning, for this reason, that the portion of the coal, which in common parlance is called "bituminous," is in a solid or fixed state while in the coal, and to which state I was then referring; though, subsequently, it is volatilizable and assumes the form of gas. I know, indeed, no other term by which these bituminous constituents, *while in the fixed state in coal*, and before they are volatilized, can be designated.

The reviewer observes, "these quotations [taken from page 26,] suffice to shew that the gases which result from the application of heat to coal, are considered by the author to be produced by *simple distillation* of the bitumen contained in the coal, which suffers thereby no alteration in its chemical composition; whereas, the truth is, that they result from the chemical decomposition of the bitumen, &c."

I beg to explain my meaning, by saying that I intended to convey

the idea that the application of heat to coal expels the bituminous and volatizable part by a distillatory process, and in corroboration of this opinion I find Dr. Ure says, "the first operation which coal undergoes on being heated in a common furnace, is, *distillation*."

I accompany the present with Dr. Ure's letter, from which I have made the above quotations.

And am, your obedient servant,
C. W. WILLIAMS.

Remarks by Andrew Ure, M.D., F.R.S., on Mr. Williams's Treatise on the Combustion of Coal.

To C. W. WILLIAMS, ESQ.

HAVING now carefully perused your treatise "On the Combustion of Coals and the Prevention of Smoke, Chemically and Practically considered," I cannot help congratulating you on the profound manner in which you have studied the phenomena of a furnace—phenomena which, like those of the freezing and boiling of water, had been for ages exhibited to the eyes of the philosopher and the engineer, without receiving from the one a scientific analysis, or leading the other to any radical improvement. You have fully demonstrated the defectiveness and fallacy of the ideas generally entertained concerning the operation of fuel in furnaces, and the errors, consequently, committed in their construction. Nothing places in a clearer light the heedlessness of mankind to the most instructive lessons than their neglecting to perceive the difficulty of duly intermingling air with inflammable vapours, for the purpose of their combustion, as exhibited in the every day occurrence of the flame of a tallow candle, or common oil lamp; for, though this flame be in contact, externally, with a current of air created by itself, yet a large portion of the tallow and oil passes off unconsumed, with a great loss of the light and heat which they are capable of producing. Your quotations and remarks upon this subject must convince every unprejudiced mind of the justness of your views as to the imperfect combustion of the inflammable gases given out by coals on the furnace grate.

By experiments with Dr. Wollaston's Differential Barometer, made in several factories, where both high and low pressure steam was employed, I found, that the aërial products of combustion from the boiler furnaces flew off with a velocity of fully 36 feet per second;* a rate so rapid as to preclude the possibility of the hydrogenated gases from the ignited coals becoming so duly blended with the atmospheric oxygen as to be burned. It is well known, that elastic fluids of different densities, such as air and carburetted hydrogen, intermingle *very slowly;* but, when the air becomes conbonated, as it does in passing through the grate, and, consequently, heavier, it will not incorporate at all with the lighter combustible gases above it, in the short interval of the aërial transit through the furnace and flues. Thus there can be no more combustion amidst these gases and vapours than in the axis of a tallow candle flame.

Your atomic representations are quite correct, and will please all those who delight in tracing the workings of nature into her formerly mysterious and inaccessible sanctuary.

You will remember that when, about ten months ago, you laid before me the first draught of the specification of your patent furnace, with what delight I hailed your invention as the harbinger of a brighter day for steam navigation, where economy of fuel has become the *sine quâ non* in regard to long voyages. I rejoice that, with the ample means placed at your command, you have since prosecuted the subject, through all its ambiguities, to a clear and conclusive demonstration of the efficacy of your plan for calling forth from pit-coal all its dormant fire, and diffusing it most efficaciously over the surfaces of boilers and along the flues. I am more particularly pleased with your analysis of the combustion of the gases and vapours given out by hydrogenous coal, commonly, though incorrectly, called bituminous, for it contains no ready-formed bitumen, but merely its elements, carbon, hydrogen, and oxygen.

Having been much engaged, during the two preceding years, in experimental researches upon the calorific powers of different species of fuel, † I became aware that the hydrogenous constituents of coal underwent a most imperfect combustion, and found I had been misled for some time to the false conclusion, that the caking Newcastle coals afforded less heat than the non-hydrogenous anthracite of Wales. When I improved my method of burning the gaseous products first disengaged from coals, I obtained a greater quantity of heat from the so-called bituminous species; a result quite in accordance with long established chemical data. The immortal Lavoisier and Laplace ascertained, that one pound of hydrogen, when burned in their celebrated calorimeter, melted 295·6 lb. of ice, while one pound of charcoal melted only 95·6 lb., quantities very nearly in the ratio of 3 to 1; Despretz gives the ratio of 315 to 104; thus proving beyond a doubt, that hydrogen can disengage, in its combustion, three times more heat than the same weight of charcoal. It deserves to be remarked, that this ratio is exactly the inverse of that in which hydrogen and carbon unite with oxygen; for 1 part of hydrogen, by weight, combines with 8 of oxygen to form water; and 3 parts of carbon combine with 8 of oxygen to form carbonic acid gas, which is the product of the complete combustion of charcoal. From these and similar researches, chemists have been led to conclude, that the heat afforded by different bodies in the act of their combustion is proportional to the quantity of oxygen which they consume; a conclusion which accords, also, with the principle, that the intensity of heat is proportional to the intensity of chemical action, as measured by the proportion of oxygen which enters into combination.

For the first accurate analysis of pit-coals, we are indebted to Mr. Thomas Richardson of Newcastle,* who published, a few years ago, in the eleventh volume of Erdmann's Journal für Chemie, the results of an excellent series of researches on coals, made in Professor Liebig's laboratory. He used the fused chromate of lead to oxygenate the carbon and hydrogen of the coals, with Liebig's new apparatus; and his results deserve entire confidence. In the earlier analyses of coals, made by Dr. Thomson, myself, and others, the peroxide of copper, which was employed to oxygenate the combustible matter, always left some of the carbon unconsumed, and thus occasioned unavoidable errors.

1. Rich caking coal, from Garesfield, near Newcastle, of sp. grav. 1·280, was found to contain as follows:

Carbon	87·952
Hydrogen	5·239
Azote and oxygen	5·416
Ashes	1·393
	100·

2. Caking coal, of excellent quality, from South Hetton, in the county of Durham, of sp. grav. 1·274, afforded,

Carbon	83·274
Hydrogen	5·171
Azote and oxygen	9·036
Ashes	2·519
	100·

3. The parrot coal of Edinburgh afforded,

Carbon	67·597
Hydrogen	5·405
Azote and oxygen	12.432
Ashes	14·566
	100·

100 parts of these several kinds of coal take for perfect combustion (subtracting the oxygen contained in the coal) as follows:

1st. 266·7 parts of oxygen:	giving out heat as the number	122·56
2nd. 250·2 „	„ „	114·98
3rd. 217·6 „	„ „	100·00

The quantity of heat is here presumed to be proportional to the quantity of oxygen consumed. M. Regnault published, in Erdmann's Journal, vol. xiii., p. 69, the following statement of his analysis of coals, which is regarded by Professor Löwig as very correct:†

Newcastle coal, of sp. grav. 1·280, affording a much inflated coke, (quite akin to the Garesfield coal, if not the same,) was found to consist of carbon, 87·95; hydrogen, 5·24; azote and oxygen, 5·41.

A Lancashire coal, of sp. grav. 1·317, which afforded an inflated coke, was found composed of carbon, 83·75; hydrogen, 5·66; azote and oxygen, 8·04. The quantity of azote is not given separately by either Mr. Richardson or M. Regnault; but it is known to be inconsiderable. The deficit to 100 in his analyses represents the amount of ashes per cent. Mr. R. says: "With the present means of analysis at our disposal, it is impossible to determine the true amount," (of azote,) "but the coal cannot contain more than two per cent." In the Edinburgh coal he found, by an experiment made on purpose to determine this point, 0·38 per cent. of azote. This uncertainty introduces a proportional ambiguity into the calculation of the quantity of heat evolved, from the quantity of atmospherical oxygen consumed. The less the proportion of azote, in the above analysis, the greater will be that of the oxygen directly combined with the coals, and the less atmospherical oxygen, of course, will be consumed, which is the only source of the heat disengaged.

Since it is the proportion of hydrogen in coal that determines the proportion of volatile products, a tolerable approximation upon this point is afforded by the proportional loss of weight which different coals suffer from ignition in retorts or covered crucibles. I found that 100 parts of the Felling-main coal used by some of the London Gas Companies, when strongly ignited in a covered crucible, well-luted, lost 37·5 per cent., leaving 62·5 of a porous coke. The Llangennock coals from Caermarthenshire, of sp. grav. 1·337, lose by ignition only 15·5, and leave 84·5 of a rather dense coke, which contains 3 of ashes. In furnaces of the common construction about London this coal affords much heat with little smoke, and is, therefore, greatly in request, and fetches a high price. 100 parts of the Tanfield Moor coal, of sp. grav. 1·269,

† An account of these experiments was laid before the meeting of the British Association, at Birmingham, and printed in the *Athenæum* of September 14, 1839.

* Experimental Inquiry into the Modes of Warming and Ventilating Apartments, in reference to the Health of their Inmates. By Andrew Ure, M.D., F.R.S. Read before the Royal Society, 16th June, 1836.

* An account of these experiments has been since presented, by Mr. Richardson, to the Natural History Society of Newcastle-upon-Tyne, and is printed in their Transactions, vol. ii., p. 401, and in the London and Edinburgh Philos. Magazine, vol. xiii., p. 121, for August, 1838.

† Chemie der Organischen Verbindungen, vol. ii., p. 88.

preferred by blacksmiths for their forge on account of its calorific strength and freedom from sulphur, give off in ignition 32·5 parts, and leave 67·5 of a bulky, compact coke.

Every coal which contains much hydrogen, and, therefore, loses much weight by ignition in retorts, necessarily produces much smoke, with a great waste of heat in our common steam boiler furnaces, for reasons which you have so well developed in your treatise. "When a carburetted hydrogen," says Liebig, "is kindled, and just as much oxygen admitted to it as will consume its hydrogen, the carbon does not burn at all, but is deposited (or separated) in the form of soot; if the quantity of oxygen is not sufficient to burn even all the hydrogen, carburets of hydrogen are produced poorer in hydrogen than the original carburetted hydrogen."† The above gas and smithy coals which, from their richness in hydrogen, are capable of affording the greatest proportion of heat by thorough combustion, afford often a much smaller quantity than the Llangennock, because the carburetted hydrogen which they so abundantly evolve is not supplied with a *due* quantity of oxygen, and hence much of their carbon goes off in smoke, and their sub-carburetted hydrogen gas in an invisible form. These results are quite accordant with my experiments on these coals with my calorimeter. At first, from certain defects in the apparatus, whereby the coals were imperfectly burned and a good deal of smoke was disengaged, I found that the best coals imported into London, such as Lambton's Wallsend, Hetton Do. and Pole's Main, afforded a smaller proportion of heat than the Llangennock, or even anthracite; but, when I diminished these defects, I obtained much more heat from the Tanfield Moor coal than from the Llangennock, and more from this than from the anthracite. In fact, a coal which, like the Newcastle caking coal, contains 5·239 of hydrogen, is capable of giving out in complete combustion as much heat as if it contained an extra 10½ per cent. of carbon; but, instead of this additional heat, it affords in common furnaces much less heat than the Llangennock, though this is much poorer in the most calorific constituent, viz., the hydrogen.

It is a remarkable fact, that an inflammable constituent of pit-coal, which is always present, and often invisibly combined with it to the amount of 5 per cent. or more, has never been noticed in any of the ultimate analyses hitherto published. I have examined a great variety of coals from different parts of the world, and I have seldom found less than 2 per cent. of sulphur in them. Now, this is a circumstance of great consequence to many manufacturers, and most essentially to iron-masters. Some of my results upon this subject were published in the number of the Athenæum above quoted. Sulphur in its calorific power ranks low, being, according to Dr. Dalton, one-half of carbon. If we assume its consumption of oxygen in combustion as the measure of its heating power, it will stand to carbon in the relation of 3 to 8; for 3 parts of carbon consume 8 of oxygen to form carbonic acid, while 8 of sulphur consume 8 of oxygen when they are burned into sulphurous acid. The blacksmith knows well what havoc a sulphurous coal makes among his iron in the forge, rendering it entirely *rotten*. The same operation takes place upon the rivets and plates of steam-boilers, when the sulphur of the coals is merely volatilized, without being mingled with sufficient air to burn it.

The first operation which coals undergo on being heaved into a common furnace, is distillation, attended with a great absorption of heat, and may be compared to the distillation of sulphur in the process of refining it, for which purpose much external heat is requited. But, if the fumes of sulphur or the coals be, after accension, intermingled with the due quantity of atmospherical oxygen, they will, on the contrary, generate internally from the beginning their respective calorific effects.

At the outset of my chemical career I suffered in a painful and dangerous way from the refrigeration produced by throwing some pit-coal into a hot furnace. I was extracting oxygen, for common class experiments, from nitre ignited in a large iron bottle, when, having replenished the fire with coal, the gas became condensed in the bottle so much as to occasion a regurgitation of water into it from the gasometer basin, which water, being instantly converted into high-pressure steam, drove out a quantity of red-hot nitre upon my shoulder and arm, so as to burn not only my clothes, but a very considerable portion of my skin. In an experimental furnace, so treated, the heat is greatly damped as long as the hydrogenated vapours and gases are being generated; and it becomes again effective only when the coals have become nearly charred. Were there a contrivance like your patent invention introduced into the furnace for diffusing atmospherical oxygen through the said vapours and gases, no vexatious refrigeration could ensue from feeding the fire prudently, with common pit-coal; and the external orifice through which this smoke-burning air was admitted, might be closed whenever the fire became clear.

In the case of great steam-boiler furnaces, for which your patent is especially intended, since these are fed at short intervals, your plan of distributing atmospheric air, in a regulated quantity, by numerous jets, through the body of the gasiform matter, is peculiarly happy, and enable you to extract the whole heat which the combustible is capable of affording. The method also which you have contrived for distributing the air under the surface of the grate will ensure due combustion of the coked coals lying there, without admitting a refrigerating blast to the fire. And, finally, your mode of supplying atmospherical oxygen will prevent the possibility of the carbon of the coals escaping in the state of carbonic oxide gas, whereby, at present, much heat is lost in our great furnaces.

ANDREW URE.

1, *Charlotte-street, Bedford-square, London,*
December 26, 1840.

† Traité de Chimie Organique, Introduction, p. 32.

LECOUNT'S HISTORY OF THE LONDON AND BIRMINGHAM RAILWAY.

SIR—In your last number you have unintentionally done me an injury, which I have no doubt you will redress by admitting this letter. I allude to your stating that my history of the London and Birmingham Railway is a reprint from Mr. Roscoe's. I beg to say this is not the case beyond the 32nd page; the remainder of my work is what it proposes to be, a history of the railway in question, which Mr. Roscoe's is not beyond page 32—after that point I had nothing whatever to do with it, principally on the account that it was professing what was not to be performed. My name being connected with it is a perfect hoax upon the public; I never saw a proof sheet after page 32; and I may add that what I furnished for that work, although done under a written agreement, has never got me a sight of sixpence of the publisher's money. Beyond the point named it may be just as correctly called my history of the Cock Lane ghost, as my history of the Birmingham railway; I had nothing whatever to do with it except as above explained

Your obedient servant,

Wellington Road, Birmingham, P. LECOUNT.
January 7, 1841.

[We should regret extremely that any unintentional error of ours should be the means of injuring Lieut. Lecount, for whose public services we entertain great respect, perhaps his letter will be deemed a sufficient explanation. —ED. C. E. & A. JOURNAL.]

IMPROVEMENTS ON ECCENTRIC RODS.

Fig. 1.

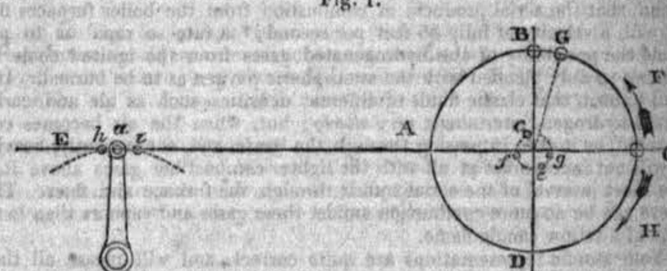
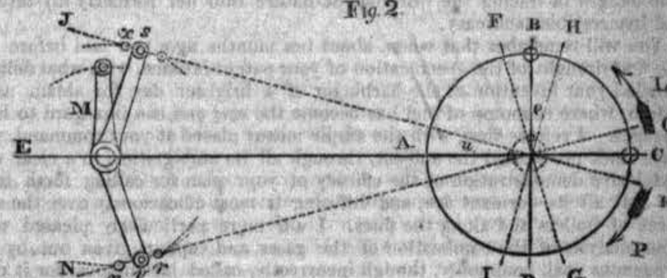


Fig. 2



[We very much regret that, through the inadvertence of our wood engraver, several letters of reference were omitted in Mr. Pearce's diagrams given in last month's Journal; we have therefore thought it our duty to re-insert them, together with the following communications.]

SIR—I beg to call your attention to my communication on Eccentrics for working the slide valves of Locomotive Engines, which you were pleased to insert in the last number of your widely circulated Journal.

On reading the explanation of the engravings, I find that the greater part of the letters of reference are not inserted in the figures; this omission, I think you will perceive, renders the most important point of the subject unintelligible, and I have, therefore, taken the liberty to apprise you of the same, hoping that you will be induced to correct the deficiency by the insertion of the figures complete in your next number. I also beg to point out the two following typographical omissions. In the 5th line of the 6th paragraph, instead of "Suppose it to be, &c." it ought to have been "Suppose *the crank* to be, &c.," and in the 11th line of the last paragraph, instead of "caused to be, &c." it ought to have been "caused *not* to be, &c."

I remain, Sir,
Your obliged servant,

Leeds, JOHN C. PEARCE.
Jan. 13*th*, 1841.

SIR—I have subscribed to your periodical from its commencement, and received from it much pleasure and useful information. I have been still more gratified of late with the increase of space devoted to my favourite study, mechanics, and it is to a paper of this nature in your January number, that I wish at present to direct your attention. A correspondent of the name of John Charles Pearce describes, at considerable length, a contrivance for reversing a steam-engine with one eccentric as an invention of his own, although it has long been quite common in this country. I may mention, as an example, a high-pressure engine of about 20 horse power, built for some experiments with a canal boat on the Forth and Clyde Canal, and afterwards altered as a pumping-engine for a dry dock at Grangemouth, in which the identical contrivance was applied successfully.

I am,
Your constant reader,
AN APPRENTICE.

Glasgow,
11th Jan. 1841.

SIR—If I am trespassing too much on your columns by thus a second time requesting the favour of a place therein, I beg you will suppress, curtail, or defer, as you think best, the following remarks which I am induced to send you after the perusal of a communication from Mr. John Charles Pearce, inserted in your number for the present month.

Mr. J. C. Pearce is correct in his observation as to the possibility of working Locomotive Engines by two fixed eccentrics, but he overlooks an objection to this system which, with your permission, I will take the liberty to point out: previous however to entering upon the objection, it will be proper to explain a few conditions, which are inseparable from this system of two fixed eccentrics, and in one of which, originates the above mentioned objection.

No. 1. The eccentric must precede the crank in its action, when the engine is going forward, otherwise no *lead* can be given without a complication of levers; a slight objection was made to this, inasmuch that for going forward, the eccentric rod must work the upper pin of the double lever of the valve motion, and must be held in gear, so that should any thing get wrong in the hand motion, the eccentric rod would fall out of gear, and would thus reverse the engine.

No. 2. The crank being placed in a horizontal position, so that the piston may be at one end of the cylinder, the eccentric must be placed exactly perpendicular to Mr. J. C. Pearce's line C E, which is a straight line drawn through the centre of the crank shaft, and the lever spindle of the valve motion.

No. 3. The *amount* of *lead* depends upon the length of the eccentric rod. The shorter this rod is the greater will be the *lead*.

No. 4. The *lead* being determined by the length of this rod must remain invariable unless you move the eccentric on the axle, in which case you increase the *amount* of the *lead* one way, *but you diminish it for the reverse motion.*

This last circumstance has been deemed objectionable, because with varying loads and speed, it is desirable to have the power of augmenting or diminishing the *amount* of the *lead*.

Several engines are at work on the Paris and St. Germain railway fitted each with two fixed eccentrics, upon the principle laid down by Mr. J. C. Pearce, and for which a patent was obtained in Paris, I believe in 1838. They work well, but in consequence of the above mentioned inconveniences are being fitted with four eccentrics.

I have had several opportunities of comparing the duty done by these engines with that of others having four eccentrics, and at work on the same line, and have found very little difference in their results. I have reason to believe that the determination to alter them, originated more than from any other cause, in the desire of the Company to assimilate all their engines, by adopting one uniform system of eccentric motion; it is proper here to observe that the eccentric rods of these engines were originally made too long, and did not give sufficient *lead* to the valves, that in consequence thereof, the eccentrics were advanced a little on the shaft, so as to give the required *lead* for going forward, and the engines were *thus rendered slow the back way*.

The same Company fitted a pair of fixed eccentrics to another engine, paying proper attention to the length of the eccentric rods in order to obtain the required *lead* both ways; the eccentric rods were in this instance so short, as to work with a disagreeable motion, because the suspension pin of the hand lever motion, which in consequence of the shortness of the eccentric rods was attached to them, comparatively nearer than usual to the eccentric, occasioned an up and down motion of the fork upon the pin of the lever of the valve motion, which made it requisite to make the parallel clutch of the fork much deeper than usual, to prevent it from flying out of gear; this might, it is true, have been easily remedied, but the Company not being willing to make any further outlay in experiments, and desirous to have their engine, replaced the whole affair by four eccentrics.

The most serious objection made to the two fixed eccentrics, in my opinion, rests on the impossibility of varying the *lead of the valves both ways*.

The original plan adopted of two moveable eccentrics is a very good one, because if any thing gets out of order with the motion, you can always work home by hand. The main objections are, their expence, and the difficulty of getting them sufficiently strong.

The four eccentrics act perfectly well, but render the valve motion so very crowded, as to be frequently inconvenient.

A very ingenious method has been proposed and executed by Messrs. Hawthorn, brothers, of Newcastle-upon-Tyne, for replacing the eccentrics altogether, by a motion taken from the body of the connecting rods; the *lead* has been very cleverly determined by these gentlemen; the same objection however exist as to the difficulty of varying the *lead*, which could only be removed by complicating the motion. I have seen an engine of this description at work and giving satisfaction.

I remain, Sir, your very humble servant,
H. E.

London, January 16, 1841.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

ROYAL INSTITUTE OF BRITISH ARCHITECTS.

Jan. 11.—J. B. PAPWORTH, Esq., in the Chair.

A paper was read by Mr. E. I'Anson, Jun., Fellow, comparing the Campanili of the lower ages in Italy, with those of the Norman period in England. The matter of Mr. I'Anson's discourse went to illustrate that highly interesting subject, the spread of the Romanesque style of architecture, and the modifications it underwent in its progress.

Jan. 25.—H. E. KENDALL, Esq., in the Chair.

A paper was read on the Construction of the Reservoirs from which Venice is supplied with fresh water, by C. Parker, Fellow. This city being dependant on the clouds for a supply of this most necessary element, means are provided for collecting the rain water in immense tanks, which it enters by filtration through beds of sand, the means by which natural reservoirs are fitted, and their contents purified, being in fact imitated by art. The mode of constructing and puddling these tanks was described in detail, and illustrated by plans and sections.

An Artesian well lately constructed at the Surrey County Lunatic Asylum, was described by Mr. S. Lapedge, Associate, and a section exhibited of the strata through which the borer has passed, to the depth of 347 feet. The water rises from a bed of dark sand to within 30 feet of the surface, and a well 190 feet deep forms a reservoir, which constantly affords a supply sufficient for the purposes of the establishment.

A drawing was presented and a discussion read of a timber bridge erected at Hulne Park, by Mr. Barnfather, architect. It is an arch of 100 feet span and 5 feet rise, constructed of balks of timber raised to a curve by means of iron wedges, and remarkable for the simplicity and economy of construction. This principle was introducted from America about 25 years ago.

The Secretary for foreign correspondence, Mr. Donaldson, read a communication from Baron Gasparin, President of the Comité Historique des Arts et Monumens, at Paris, accompanying a donation of the bulletins (or reports) of the committee.

SOCIETY OF ARTS FOR SCOTLAND.

Dec. 14, 1840.—DR. FYFE, President, in the Chair.

Mr. Galbraith read a paper *on Trigonometrical Levelling, and on the effects of a supposed local attraction at the Calton Hill, Edinburgh.* In the first part of the paper he detailed a number of observations which he had made for the purpose of determining the amount of atmospherical refraction, and described a formula for its computation considerably simpler than that in use. In the second part of his paper he detailed a series of observations for the purpose of determining the latitude of the observatory of Edinburgh, to which he had been led by a known discrepancy between the latitude determined by Professor Henderson, from observations made by the mural circle, and the latitude found from the observations made on Kelly Law, in Fife, by help of the Ordnance zenith sector. It having occurred to him that the rising of the country to the southward of the Calton Hill, and the slope northward to the Firth of Forth, may cause a local disturbance of the plumb line, he resolved on deducing the latitude of the Observatory from observations made on Inchkeith, in the middle of the Firth, where the local attractions may be expected to be balanced. The determination of the latitude of Inchkeith Light-house agreed within half a second with that found by the Ordnance surveyors, but differed by *seven seconds* from that deduced by transference from the Observatory. On this account the author conceived that the probability of the existence of a local attraction at the Calton Hill was strengthened. The paper was ordered to be printed.

Mr. Alexander exhibited *a working model of the Electric Telegraph,* having premised that the model was intended merely to illustrate elementary principles. This instrument contained a separate wire for each distinct signal: the exhibition of it gave rise to an interesting conversation, in which a number of the members took part. Mr. Ponton adverted to the modification which he had exhibited two years ago to the society, in which a sufficient number of signals were obtained by the use of three wires only; he also mentioned that during the exhibition in the Assembly rooms, he had openly talked of a method of reducing the number of wires to two, by intro-

ducing the element *time*, a simplification which has since been wrought out and patented by Professor Wheatstone.

Mr. James Robertson, late in the service of the Shah of Persia, read a paper *on the method of manufacturing Bricks in Persia*; in which a lucid and very interesting description was given of those peculiarities in the construction of the brick-kilns which are consequent on the scarcity of fuel, and the peculiarity of what fuel can be obtained. Mr. Robertson was requested to allow his paper to appear in the transactions.

Jan. 11, 1841.—The President in the Chair.

Mr. Gavin Kay exhibited *a model of a boat on skates*, which he proposed as an apparatus for saving the lives of persons who have fallen through the ice. The exhibition of this model led to an animated conversation concerning the general subject, in the course of which Dr. Hunter, Mr. Sang, and Mr. Glover, expressed opinions decidedly hostile to any cumbrous apparatus; Mr. Sang and Mr. Glover particularly insisted on the propriety of having a few men drilled to manœuvring on the frequented lochs; and the society, after thanking Mr. Kay for his communication, requested Mr. Glover to draw up a paper embodying the opinions which seemed to have prevailed, and particularly the lucid views which he himself had given.

Mr. Rose read a description of *an instrument for indicating the amount of inclined disturbances during the shocks of an Earthquake*. In introducing the subject, Mr. Rose stated that since this communication had been billeted, the very same instrument had been exhibited to the Royal Society (Edinburgh), and that, in consequence, he had thought of withdrawing the notice. Having been dissuaded from this intention, he felt it necessary to offer some explanation. The explanation was to the effect that Mr. Mylne, having been requested, along with a committee of the British Association, to devise instruments for registering the disturbances caused by earthquakes, had consulted him, and having received a description and sketch, had employed Mr. Jamieson, assistant to Mr. Lees, to construct one. This instrument Mr. Mylne had exhibited along with others to the Royal Society, without taking any notice of Mr. Rose. The instrument contained a pendulum suspended by a ball-and-socket joint, the lower extremity of the pendulum carrying a piece of chalk, which might trace, upon a blackened spherical surface, a line to indicate the amount and direction of the inclination. Mr. Rose explained that some slight friction is needed, in order to prevent the free swinging of the pendulum, and he added that very little information could be expected from instruments of this class, since, in localities where the shocks are slight, the indicators may be deficient in delicacy, while, on the occasion of severe shocks, the instrument and observers may be involved in the common ruin. Sir John Robison pointed out a difficulty which might occur in interpreting the readings of the instrument, and suggested a hollow but very flat cup containing mercury; in the sides of the cup were to be drilled a multitude of small holes, which, in the event of any disturbance, might receive and retain part of the mercury. After some conversation among the members, thanks were voted to Mr. Rose.

Mr. Thomas Davidson exhibited a simple but important *improvement in the camera for taking portraits*. This improvement consisted in placing a stop between the lens and the image, so as to cut off the worst portions of the refracted light. He also described a method proposed for the purpose of taking views by reflection. His method was to employ a perfectly spherical reflector, having a stop placed around the centre of curvature; by this means all parts of the image are obtained of equal distinctness. Sir John Robison, Dr. Hunter, and Mr. Bryson made some remarks, and Mr. Sang pointed out that the curvature of the image in this arrangement would be a source of great inconvenience. These communications were remitted to a committee.

MEETINGS OF SOCIETIES IN FEBRUARY,

At Eight o'clock in the Evening.

Institution of Civil Engineers, Tuesday	2	9	16	23
Royal Institute of British Architects, Monday	8	22		
Architectural Society, Tuesday	9	23		

STEAM NAVIGATION.

THE VOYAGE OF THE NEMESIS.

(From the Colombo Observer, Oct. 12.)

In this splendid vessel, commanded by Captain W. H. Hall, we have the pleasing task of welcoming to our shores the first iron steamer that ever rounded the Cape of Good Hope. She is the largest of her class built, being 168 feet long, 29 feet beam, and 650 tons burden. The engines are 120 horse power, by Messrs. Foster and Co., of Liverpool, and, of course, upon the best construction. Twenty days' coal can, on any emergency, be stowed in her. She carries two medium 32 pound pivot guns, one after the other forward, and 10 swivels, and is manned by 50 seamen. When launched she drew only 2½ feet water, and may still be lightened, if necessary, to 4½ feet. Being nearly flat-bottomed, and fitted with iron hawse holes for cables in the tern, she can be run on shore and easily got off again by anchors, which contrivances will enable her, in many cases, to land troops without the assistance of boats. Though thus round-bottomed, two wooden false keels, of six feet in depth, can be let down through her bottom, one after another, forward. These, together with a lee-board invented by Captain Hall on the voyage, prevent her, in a considerable degree, from going to leeward. The rudder has a corresponding construction, the true rudder going to the depth of the sternpost, and a false rudder being attached by a pivot to the former, so that it can be triced up or let down to the same depth as the false keels. The floats are easily unshipped, and under canvass, with the wind free, she can go 9 or 10 knots an hour. The vessel is divided by water-tight divisions into five compartments, so that though even both stem and stern were stove in, she would still float. Her accommodations and arrangements of small arms are splendid, and large coal-holes being placed, both between the officers' quarters and the sailors' berths and the engine-room, the heat of the fires is not at all felt. The Nemesis left Portsmouth with secret orders on the 28th of March, and reached Madeira in seven days, where she took in coals, then proceeded down the coast of Africa, steaming or sailing according to circumstances, but she experienced principally adverse winds and currents. At Prince's Island, a Portuguese settlement, she took in 70 tons of wood, which, with the remaining coals, lasted till she came into the latitude of St. Helena, when she proceeded under canvass, in order to make the best of her way to Table Bay thus facing the Southern Ocean at the very worst season of the year.

She arrived at Table Bay on the 1st of July. The Governor and suite having gone on board, she slipped from her anchorage and steamed round the bay, trying the different range of her guns. Having taken in about 200 tons of coals and water, she left Table Bay on the 11th of July, and whilst rounding the Cape, as was to be expected at that most unfavourable season, experienced several gales of wind. One of these, in particular, was most tremendous, but, to the agreeable surprise of those on board, the steamer proved to be an admirable sea-boat, rising over the immense waves with the greatest buoyancy, and shipping little or no water. She, however, received so much damage in these gales, that Captain Hall put into English river, Delagoa Bay, to repair and refit. This occupied three weeks, but was done most effectually by those on board, as she carries first-rate artificers and mple means at their disposal.

From Delagoa Bay the Nemesis proceeded to Mozambique, thence she continued her voyage towards India, calling at Johanna. She then went direct through the Maldive islands to Ceylon, sighted Colombo on Monday morning, the 7th, and reached Point de Galle the same afternoon.

The Nemesis will have to wait a few days at Point de Galle until the arrival of commissariat and other stores from Colombo, when it is supposed she will proceed to Singapore, and ultimately to China.

LIST OF NEW PATENTS.

GRANTED IN ENGLAND FROM 28TH DECEMBER, TO 28TH JANUARY, 1841.

Six Months allowed for Enrolment.

John Buchannan, of Glasgow, Coach Builder, for "*improvements in wheel carriages for common roads or railways.*"—Sealed December 28.

William Bridges Adams, of Porchester Terrace, Gent., for "*improvements in the construction of wheel carriages, and of appendages thereto.*"—December 28.

John Wells, of Vale Place, Hammersmith, Gent., for "*certain improvements in the manufacture of coke.*"—December 30.

William Henry Kempton, of the City Road, Gent., for "*improvements in cylinders to be used for printing calicoes and other fabrics.*"—Dec. 30.

Henry Adcock, of Winstanley, Civil Engineer, for "*improvements in the means or apparatus for condensing, concentrating, and evaporating aeriform and other fluids.*"—December 30.

William Heusman, of Woburn, Machinist, for "*improvements in ploughs.*"—December 31.

Joseph Parkes, of Birmingham, Button Manufacturer, for "*improvements in the manufacture of covered buttons.*"—December 31.

William Newton, of Chancery Lane, Civil Engineer, for "*improvements in the rigging of ships, and other navigable vessels.*" Communicated by a foreigner."—December 31.

Francis Burdett Whitaker, of Royton, Lancaster, Cotton Spinner, for "*improvements in the machinery or apparatus for drawing cotton and other fibrous substances, which improvements are also applicable to warping and dressing yarns of the same.*"—December 31.

Joseph Stubs, of Warrington, File Manufacturer, for "*improvements in the construction of screw wrenches and spanners, for screwing and unscrewing nuts and bolts.*" Communicated by a foreigner.—December 31.

Thomas Robert Sewell, of Carrington, Nottingham, Lace Manufacturer, for "*improvements in obtaining carbonic acid from certain mineral substances.*"—December 31.

William Henry Kempton, of Pentonville, Gent., for "*improvements in lamps.*"—December 31.

John Grylls, of Portsea, for "*improvements in machinery used for raising and lowering weights.*"—December 31.

Joseph Haley, of Manchester, Engineer, for "*an improved lifting jack, for raising or removing heavy bodies, which is also applicable to the packing or compressing of woods or other substances.*"—December 31.

Louis Holbeck, of Hammersmith, Gent., for "*improvements in obtaining or producing oil.*" Communicated by a foreigner.—December 31.

Henry Scott, of Brownlow Street, Bedford Row, Surgeon, for "*improvements in the manufacture of ink or writing fluids.*"—December 31.

Charles Golightly, of Gravel Lane, Southwark, Gent., for "*a new apparatus for obtaining motive power.*"—January 4.

George Child, of Lower Thames Street, Merchant, for "*improvements in the manufacture of bricks and tiles, part of which improvements are applicable to compressing peat and other materials.*" Communicated by a foreigner.—January 4.

John Swindells, of Manchester, Manufacturing Chemist, for "*improvements in the manufacture of artificial stone, cement, stucco, and other similar compositions.*"—January 6.

William Newton, of Chancery Lane, Civil Engineer, for "*certain improvements in looms for weaving.*" Communicated by a foreigner.—January 9.

John Rock Day, of Great Queen Street, Lincoln's Inn Fields, Sadlers' Ironmonger, for "*improvements in the construction of collars for horses and other draft animals.*"—January 6.

Henry Gunter, of Cullum Street, Fenchurch Street, Merchant, for "*improvements in preserving animal and vegetable substances.*"—January 6.

Henry Bessemer, of Perceval Street, Clerkenwell, for "*a new mode of checking the speed of or stopping railroad carriages under certain circumstances.*"—January 6.

William Thompson, of Upper North Place, Gray's Inn Road, Brush Maker, for "*improvements in the construction and mounting of various kinds of brushes and brooms.*"—January 8.

William Lacey, of Birmingham, Agent, for "*certain combinations of vitrified and metallic substances applicable to the manufacture of ornaments, and the decoration and improvements of articles of domestic utility and of household furniture, also applicable to church windows and shop lights.*"—January 11.

Matthew Uzielli, of King William Street, Merchant, for "*improvements in impregnating and preserving wood and timber for various useful purposes.*" Communicated by a foreigner.—January 11.

William Newton, of Chancery Lane, Civil Engineer, for "*improved machinery for cleaning wheat and other grain or seeds from smut and other injurious matters.*" Communicated by a foreigner.—January 11.

John Barwise, of Saint Martin's Lane, Chronometer Maker, and Alexander Bain, of 35, Wigmore Street, Cavendish Square, Machinist, for their invention of "*improvements in the application of moving power to clocks and time pieces.*"—January 11.

Thomas Harris, of Chiffnal, Salop, for "*an improved horse-shoe.*"—January 11.

Joseph Hall, of Cambridge, Grocer and Draper, for "*a seed and dust disperser, applicable to the freeing of corn and other plants from insects.*"—January 14.

Walter Hancock, of Stratford-le-Bow, Essex, for "*an improved means of preventing accidents on railways.*"—January 14.

Pierre Armand Le Comte de Fontainemoreau, of Skinner Place, Size Lane, for "*an improved machinery for carding and spinning wools and hairs, which he titles* "*Filo Finisher.*" Communicated by a foreigner.—January 14.

Melcher Gakner Todd, of the island of Saint Lucia, for "*a certain improved form of apparatus for the distilling and rectification of spirits.*"—January 14.

John Loach, of Birmingham, Brass Founder, for "*improvements in castors applicable to cabinet furniture and other purposes.*"—January 14.

William King Westley, of Leeds, Flax Merchant, for "*improvements in carding, combing, straightening, cleansing, and preparing for spinning hemp, flax and other fibrous substances.*"—January 14.

William Renworthy, of Blackburn, Spinner, and James Bullough, of the same place, Overlooker, for "*improvements in machinery, or apparatus for weaving.*"—January 14.

Charles Cameron, Esquire, of Mount Vernon, Edinburgh, for "*improvements in engines, to be actuated by steam and other elastic fluids.*"—January 14.

Samuel Hall, of Basford, Nottingham, Civil Engineer, for "*improvement in the combustion of fuel and smoke.*"—January 14.

Alexander Jones, of King Street, London, Engineer, for "*improvements in the manufacture of copper tubes and vessels.*"—January 14.

Edward Foard, of Queen's Head Lane, Islington, Machinist, for "*an improved method, or improved methods, of supplying fuel to the fire-places or grates of steam-engine boilers, brewers' coppers, and other furnaces, as well also to the fire-places employed in domestic purposes, and generally to the supplying fuel to furnaces or fire-places, in such a manner as to consume the smoke generally produced in such furnaces or fire-places.*"—January 16.

John Ames, of Plymouth, Painter, for "*a new and improved method of making paint from materials not before used for that purpose.*"—January 16.

James Smith, of Deanston Works, Kilmadock, Perth, Cotton Spinner, for "*certain improvements in the preparing, spinning, and weaving of cotton, silk, wool, and other fibrous substances, and in measuring and folding woven fabrics, and in the machines and instruments for these purposes.*"—January 19.

Thomas Robinson, of Wilmington Square, Middlesex, Esquire, for "*improvements in drying woollen and other fabrics.*"—January 19.

Thomas Vaux, of Frederic Street, Gray's Inn Lane, Worsted Manufacturer, for "*improvements in horse-shoes.*"—January 19.

Caleb Bedells, of Leicester, Manufacturer, Christopher Nickell, of York Road, Lambeth, Gentleman, and Archibald Turner, Foreman to the said Caleb Bedells, for "*improvements in the manufacture of braids and plats.*" Partly communicated by a foreigner.—January 19.

John Barber, of Manchester, Engraver, for "*improvements in machinery, for the purpose of tracing or etching designs or patterns on cylindrical surfaces.*"—January 19.

Frederick Steiner, of Hyndburn Cottage, Lancaster, Turkey Red Dyer, for "*improvements in looms for weaving and cutting asunder double-piled cloths, and a machine for winding weft to be used therein.*" Communicated by a foreigner.—January 19.

John Cox, of Georgie Mills, Edinburgh, Tanner, for "*improvements in apparatus for assisting or enabling persons to swim or float, or progress in water.*"—January 19.

Charles Berwick Curtis, of Acton, Esquire, for "*methods to be used on railways for the purpose of obviating collisions between successive trains.*"—January 19.

Angier March Perkins, of Great Coram Street, Engineer, for "*improvements in apparatus for heating by the circulation of hot water, and for the construction of pipes and tubes for such and other purposes.*"—January 21.

John Melville, of Upper Harley Street, Esquire, for "*improvements in propelling vessels.*"—January 21.

William Hill Darker, senior, and William Hill Darker, junior, both of Lambeth, Engineers, and William Wood, of Wilton, Carpet Manufacturer, for "*improvements in looms for weaving.*"—January 21.

John Bradford Furnival, of Street Ashton, Warwick, Farmer, for "*improvements in the construction and application of air-vessels.*"—January 21.

William Cooper, of Layham, Suffolk, Iron Founder, for "*an improved method of constructing thrashing-machines and other agricultural instruments.*"—January 21; two months.

Isham Baggs, of Cheltenham, Gentleman, for "*improvements in printing.*"—anuary 23; six months.

Peter Fairbairn, of Leeds, Engineer, and William Suthill, of Newcastle-upon-Tyne, Flax Spinner, for "*improvements in drawing flax, hemp, wool, silk, and other fibrous substances.*"—January 26.

Edward Henshall, of Huddersfield, Carpet Manufacturer and Merchant, for "*improvements in making, manufacturing, or producing carpets or hearth-rugs.*"—January 26; four months.

Nathaniel Lloyd, of Manchester, and Henry Robotham, of the same place, Calico Printer, for "*improvements in thickening and preparing colours for printing calicoes and other substances.*"—January 26; six months.

Nathan Waddington, of Hulme, Lancaster, Engineer, for "*improvements in the construction of steam-boilers, and furnaces for heating the same.*"—January 26.

Cornelius Alfred Jacquin, of Huggin Lane, for "*improvements in the manufacture of covered buttons, and in preparing of metal surfaces for such manufacture, and other purposes.*"—January 26.

John Bradford Furnival, of Street Ashton, Farmer, for "*improvements in evaporating fluids, applicable to the manufacture of salt, and to other purposes where evaporation of fluids is required.*" Communicated by a foreigner.—January 26.

Richard Jenkyn, of Hoyle, Cornwall, Machinist, for "*improvements in valves for hydraulic-machines.*"—January 26.

William Gall, of Beresford Terrace, Walworth, Gentleman, for "*improvements in the construction of locomotive engines, and of the carriages used on railways, applicable in part to carriages used on common roads.*" Communicated by a foreigner.—January 28.

William Currie Harrison, of Newland Street, Eaton Square, Pimlico, Engineer, for "*an improved turning-table for railway purposes.*"—January 28.

Joseph Pryor, of Wendron, Cornwall, Builder, for "*an improved thrashing-machine.*"—January 28.

TO CORRESPONDENTS.

The drawing of a "*Wood Bridge over the River Calder,*" *will appear next month.*

J. Cook *on the Curvature of the Arches of the Holy Trinity at Florence, will appear in the next Journal.*

We feel obliged to C. H. W. *for his communications; we will avail ourselves of them at an early opportunity; he will perceive that we have already taken advantage of one of them.*

We shall be happy to hear again from our Dublin correspondent.

H *in reply to* Eder *was received too late; it shall appear next month.*

We must apologize to several correspondents who have written to us for information, for not answering them; if they were aware of the numerous communications that are addressed to us, they would not be surprised at not hearing from us. If we are in possession of the information, without the necessity of going to others for it, we shall at all times feel much pleasure in answering their inquiries.

Books received too late for notice this month:—Trotter's Manual of Logarithms and Practical Mathematics; Architectural Precedents with Specifications and Working Drawings; Alderson on the Steam Engine; The Derby Arboretum.

Communications are requested to be addressed to "The Editor of the Civil Engineer and Architect's Journal,' *No.* 11, *Parliament Street, Westminster.*

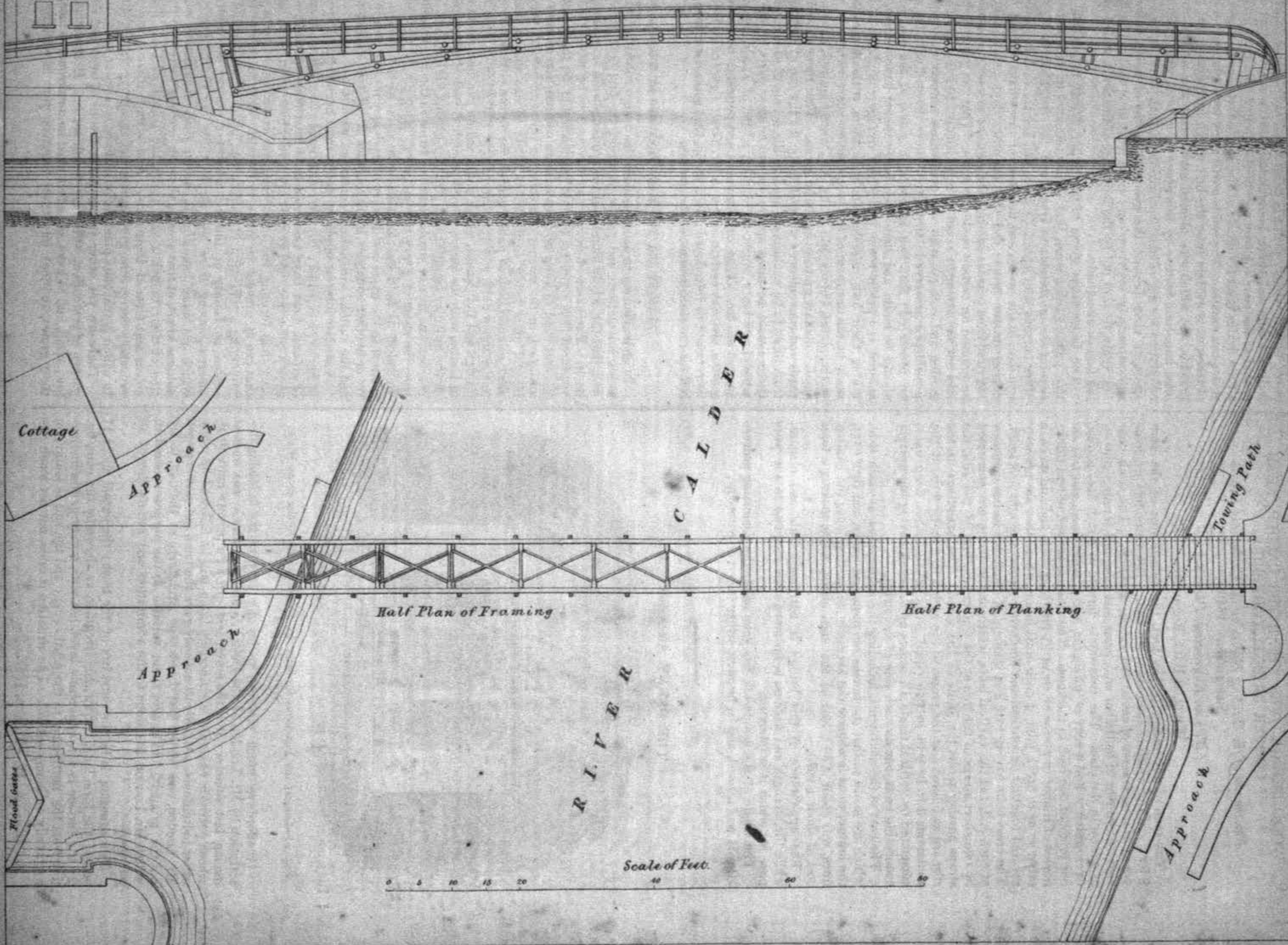
Books for review must be sent early in the month, communications on or before the 20th (if with drawings, earlier), and advertisements on or before the 25th instant.

Vols. I, II, and III, may be had, bound in cloth, price £1 each Volume.

Plan and Elevation of a Wood Bridge Built over the River Calder near Cooper Bridge, Yorkshire.

By William Bull, Civil Engineer,

1840.



J. R. Jobbins, Litho. Warwick Ct.

WOOD BRIDGE OVER THE RIVER CALDER, NEAR COOPER BRIDGE, YORKSHIRE.

For the use of the Hauling Horses on the Calder and Hebble Navigation. 1840.

(With an Engraving, Plate 3.*)*

William Bull, Engineer.

The span of this bridge is 150 feet, the versed sine of the arch 8 feet, and the width of the roadway 8 feet. The abutments are composed of solid masses of ashlar and rubble masonry. The arch consists of two ribs of fir timber with cross and diagonal framing pieces, as shown in the plan. The roadway is formed of 3 inch deal planks, over which is laid a coat of pitch, tar, and gravel mixed, and laid on hot to about one inch in thickness. The ribs are formed of two thicknesses of timber in pieces of about 21 feet long each, and laid on each other so as to break joint at each cross brace, where they are properly secured together by vertical and horizontal (cross) wrought iron bolts. The cross bolts having cast iron washers of about ten inches diameter at each end, and the vertical bolts, which are in pairs, are connected by two short straps of flat iron at the top and bottom of the ribs, the straps passing across the joints of the wood. The scantlings of the ribs are as follows: at the crown of the arch 2 ft. 2 in. by 9 in., at the abutments 3 ft. by 9 in. in two equal parts of 18 inches deep each, connected by vertical struts 13 inches by 6 inches, having the upright connecting bolts, one on each side of the struts.

The cost of the abutments, including the approaches at each side, which are made so that the horses can pass, first under, and then over, the bridge, so as to obviate the necessity of casting loose the hauling lines, was about £600, and of the arch about £470, making a total cost of about £1070.

The appearance of this bridge is extremely light and elegant, while the strength and stiffness is far more than adequate to the purpose for which it is intended.

The whole of the woodwork has gone under the Kyanizing process after it was framed, and is, besides, either tarred or painted.

THE DERBY ARBORETUM.

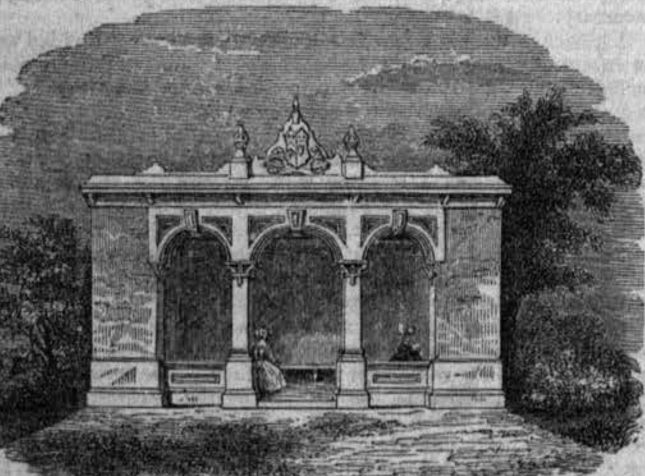


Fig. 1.—One of the Pavilions forming the Terminations to the cross Walk. Style of James I.

[It affords us much pleasure to be able to give the following description by Mr. Loudon of the Derby Arboretum, which was opened during last summer; it is the munificent gift of a private individual, whose patriotic example we sincerely hope will be followed by many other individuals. Mr. Strutt not only gave the land, but also engaged Mr. Loudon, one of the first Landscape Architects of the day, to lay out the grounds, and render them suitable to the purposes intended, which Mr. Loudon has done to the admiration and satisfaction of all parties.]

The situation is in the outskirts of the town; the extent about 11 acres; the form long, narrow, and irregular, as shown by the plan, fig. 2; the surface is flat, apparently level, but with a very gentle inclination from the north-east to the south-west; and the soil is loamy, on a gravelly or loamy subsoil. The situation is open, but not much exposed to high winds; water is to be found at the usual depth to which wells are dug, and there is one small pond which is never dry at any period of the year. Every part of the ground admits of drainage; but all the drains must terminate at the south-east corner, where alone the water can escape. The soil is particularly well adapted for the growth of trees, as is evident from the belt which surrounds great part of the grounds, and which was planted some years ago by Mr. Strutt. The most important feature in this piece of ground, with reference to its adaptation for a garden of recreation, is, that there is no distant prospect, or view beyond the grounds, worthy of being taken into consideration in laying them out; or at least none that may not, in a very few years, be shut out by the buildings of the town, which are increasing fast on every side.

The instructions given to me by Mr. Strutt respecting laying out this public garden were, that it was intended to be a place of recreation for the inhabitants of Derby and the neighbourhood, and for all other persons who chose to come and see it; that it should be open two days in the week, and that one of these days should be Sunday, during proper hours; and that on other days a small sum should be required from persons entering the garden; or yearly admissions should be granted for certain moderate sums. That the gardens should be so laid out and arranged as not to be expensive to keep up; that a flower garden and cottage, with the plantations already existing, should, if possible, be preserved; that a tool-house covered with ivy should also be preserved; that two lodges with gates, at the two extremities, should be built; and that each lodge should have a room, to be considered as a public room, into which strangers might go and sit down, taking their own refreshments with them, without any charge being made by the occupant of the lodge, unless some assistance, such as hot water, plates, knives and forks, &c., were required, in which case a small voluntary gratuity might be given. That there should be proper yards and conveniences at each lodge for the use of the public, apart from those to be exclusively used by the occupant of the lodge. That there should be open spaces in two or more parts of the garden, in which large tents might be pitched, a band of music placed, dancing carried on, &c. That certain vases and pedestals now in the flower-garden, and also certain others in Mr. Strutt's garden in Derby, should be retained or introduced; and, finally, that some directions should be left for the management of the garden.

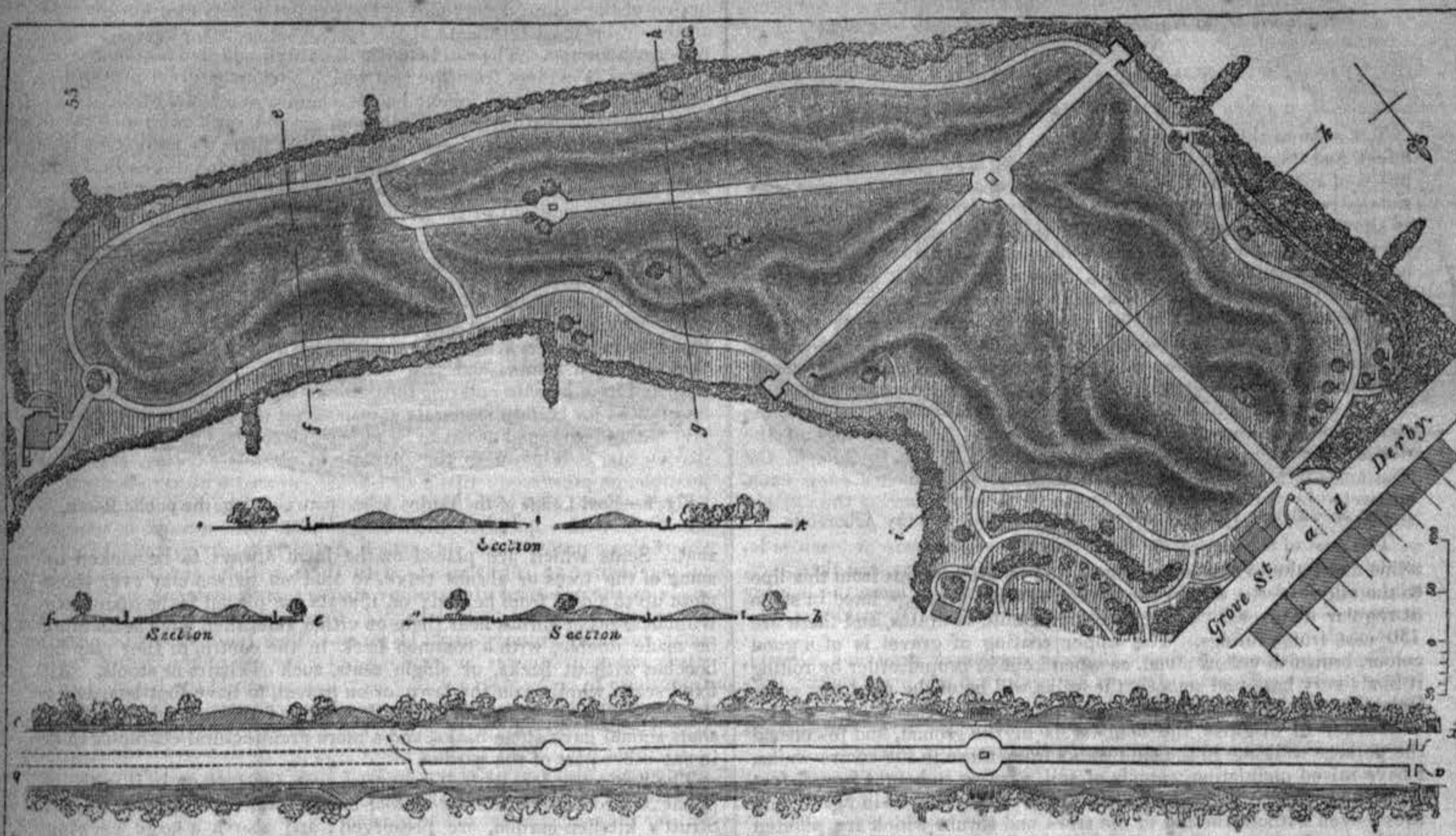
REASONS FOR THE MAIN FEATURES OF THE PLAN.

In endeavouring to accommodate the design submitted to Mr. Strutt to his instructions and to the situation, the first point determined on was, that the whole interest of the garden should be contained within itself. The mode of doing this was next to be considered; when it appeared that a general botanic garden would be too expensive, both to create and to keep up; that a mere composition of trees and shrubs with turf, in the manner of a common pleasure-ground, would become insipid after being seen two or three times; and, in short, that the most suitable kind of public garden, for all the circumstances included in the above data, was an arboretum, or collection of trees and shrubs, foreign and indigenous, which would endure the open air in the climate of Derby, with the names placed to each. Such a collection will have all the ordinary beauties of a pleasure-ground viewed as a whole; and yet, from no tree or shrub occurring twice in the whole collection, and from the name of every tree and shrub being placed against it, an inducement is held out for those who walk in the garden to take an interest in the name and history of each species, its uses in this country or in other countries, its appearance at different seasons of the year, and the various associations connected with it.

A similar interest might, no doubt, have been created by a collection of herbaceous plants; but this collection, to be effective in such a space of ground, must have amounted to at least 5000 species; and to form such a collection, and keep it up, would have been much more expensive than forming the most complete collection of trees and shrubs that can at present be made in Britain. It is further to be observed respecting a collection of herbaceous plants, that it would have presented no beauty or interest whatever during the winter season; whereas, among trees and shrubs, there are all the evergreen kinds, which are more beautiful in winter than in summer; while the deciduous kinds, at that season, show an endless variety in the ramification of their branches and spray, the colour of their bark, and the colour and form of their buds. Add also, that trees and shrubs, and especially evergreens, give shelter and encouragement to singing birds, to which herbaceous plants offer little or no shelter or food.

There are yet other arguments in favour of trees and shrubs for a garden of recreation, which are worth notice. Herbaceous plants are low, small, and to have any effect must be numerous; while, to acquire their names, and look into their beauties, persons walking in the gar-

Fig. 2.—Plan of the Arboretum.



den must stand still, and stoop down, which, when repeated several times, would soon, instead of a recreation, become very fatiguing. Now trees and shrubs are large objects, and there is scarcely one of them the beauty of which may not be seen and enjoyed by the spectator while he is walking past it, and without standing still at all. A herbaceous plant is chiefly interesting for its flowers, and the form of its foliage, in which in general there is little change of colour; but, to these two sources of interest, trees and shrubs add the opening buds in spring, the colour of the expanded foliage immediately after it has burst from the bud, the fine green tinged with some other colour which the first leaves assume when they are fully expanded, and which continues more or less till the middle of June; the intensely deep green of summer, which continues till the end of July; the first changes of autumn to red or yellow, which commence in August; and the dying off of all the different shades of red, crimson, yellow, orange, brown, and purple, which continues taking place till Christmas; while some deciduous trees, such as the beech and hornbeam, the common oak in certain soils kept moist, and the *Quércus Taúzin* in all soils and situations, retain their leaves, after they have become brown, till the following May. There are also, in deciduous trees, the colour and bloom of the young shoots of the current year; the different colour which the bark of these shoots in many cases assumes the year following (*Sàlix decípiens*, for example); and the colour and texture of the older shoots, and of the branches and trunk. In addition to these sources of interest, there is a very great beauty in trees, which, from the improper planting of artificial plantations, is often overlooked, or rather concealed; and that is, the ramification of the main surface roots at the point where they join the trunk. In general, trees are planted so deep that this ramification never appears above the surface, and the trunk of the tree seems fixed in the ground like a post which had been driven into it; an appearance as contrary to truth and nature, and also to the health of the tree, as the shaft of a column without a base or a capital would, if employed in a building, be to architectural taste. To prevent this monstrous and unnatural appearance from occurring in the Derby Arboretum, I have directed all the trees to be planted on little hills, the width of the base being three times the height of the hill, so that the junction of the main roots with the base of the trunk will appear above ground.

Much more might be said to justify the preference which I have given to an arboretum over every other kind of arrangement for the Derby Garden, but I consider any farther remarks on the subject unnecessary.

A glance at the plan, fig. 2, will show that I have provided as great an extent of gravel walk as he space would admit of; the total length, including the walk round the flower-garden, exceeding a mile. There is a straight broad walk in the centre, as a main feature from the principal entrance; an intersecting broad straight walk to form a centre to the garden, and to constitute a point of radiation to all the other walks; and there is a winding walk surrounding the whole. As a straight walk without a terminating object is felt to be deficient in meaning, a statue on a pedestal is proposed for the radiating centre in fig. 2; a pedestal, with a vase, urn, or other object, for the second circle in the straight walk, fig. 2; while the pavilions, (fig. 1,) form terminating objects to the broad cross walk.

As a terminal object gives meaning to a straight walk leading to it, so it is only by creating artificial obstructions that meaning can be given to a winding walk over a flat surface. These obstructions may either be inequalities in the ground, or the occurrence of trees or shrubs in the line which the walk would otherwise have taken, so as to force it to bend out of that line. Both these resources have been employed in laying down the direction of the surrounding walk, though its deviation from a straight line has chiefly been made in conformity with the varying position of the trees in the belt already existing. This belt, and also the trees in the flower-garden, and in other parts of the plan, which were there previously to commencing operations, and which are left conformably to Mr. Strutt's instructions, are shown in the plan fig. 2. The point of junction of one walk with another is always noticeable in an artistical point of view, and affords an excuse for putting down sculptural or other ornamental objects at these points; we have therefore placed Mr. Strutt's pedestals and vases in positions where, if they are kept properly supplied during summer with pots of flowers (the pot being placed in the inside of the vase so as not to be seen), they will form very ornamental objects; and, the names of the flowers being written conspicuously on a card, and tied round the narrow part of each vase, and the kinds of flowers changed at least once a week, they will be instructive as well as ornamental. The kinds of plants should be such as have conspicuous red or orange flowers, in order to contrast harmoniously with the masses of green foliage and grass with which they are surrounded.

All the walks are drained by semicylindrical tiles laid on flat tiles in

Fig. 3.—Interior View of the main Entrance to the Derby Arboretum. Style Elizabethan.

a line along the centre of the walk, and by cross drains from this line to the edges of the walk, communicating with gratings fixed in stone at regular distances. There is nearly a mile of drains, and there are 150 cast iron gratings. The upper coating of gravel is of a good colour, brownish yellow; and, as when kept in proper order by rolling it binds very hard and smooth, the walks will be of the most dry, comfortable, durable, and agreeable description.

In order to disguise the boundaries of the ground, and to conceal the persons walking in the side walks from those in the centre walks, I have raised undulating mounds of soil, varying in height from 7 feet to 10 feet, in the directions indicated by the shadows in fig. 2; and these, even without the aid of the trees and shrubs which are planted on them, effectually answer the ends proposed. Certain spaces on the lawn throughout the garden are left perfectly smooth and level, on which tents may be fixed, or parties may dance, &c. I should have made certain hollows and winding hollow valleys, as well as the hills and winding ridges; but the retentive nature of the soil, the difficulty, or rather the absolute want, of drainage for such hollows, as well as the very limited space, and the necessity of having a broad, straight, nearly level walk down the centre, rendered this impracticable.

In moving the ground, care has been taken to preserve some of the old surface soil to form the new surface; and this new surface has also been drained where necessary, and every where rendered perfectly smooth and even, by raking and rolling, before sowing the grass seeds.

The seats have been designed and placed, chiefly by Mr. Strutt himself, reference being had to the following rules:—To make choice of situations under the shade of trees already existing in the belts, or of situations where some kind of view or feature is obtained; to place some in gravelled recesses along the sides of the walks, and others on the turf; some open to the sun for winter use; but the most part looking to the east, west, or north, for summer use. Those seats which are placed in recesses ought to be 1 foot back from the edge of the walk, in order that the feet of persons sitting on them may not be in the way of passers by; and the gravelled recess should extend 6 inches beyond the seat behind and at each end, for the sake of distinctness, and to prevent any difficulty in weeding the gravel or mowing the grass. No seat should be put down, along the walks, in such a situation as to allow persons approaching it to see the back of the seat before they see the front of it; and, hence, the seats should generally be placed in the concavities of the turns of walks rather than in the convexities of bends. No seat to be put down where there is not either a considerable space directly in front, or at an angle of 45°, or some other equal and large angle on each side. No seat to be put down where there will be any temptation to the persons sitting on it to strain the eye looking to the extreme right or left. None to be put down where more than one point of the boundary of the garden can be seen from the seat. None to be put down on the tops of the mounds, by which a person sitting would, at least before the trees and shrubs grow up, get a panoramic view of the entire garden, and thus defeat the main object of the mounds, and of the winding direction of the side walks. No seat to be put down, nor any device contrived, by which both the lodges can be seen at once from the same point of view; or even where one of the lodges and one of the pavilions can be seen from the same

Fig. 4—East Lodge of the Derby Arboretum, showing the public Room. Tudor Style, time of Henry VII.

seat. Seats which are placed on the lawn always to be backed by some of the trees or shrubs there, so that no person may ever come close up to a seat from behind; or, if seats are placed in the open lawn without trees or shrubs near them on either side, then such seats must be made double, with a common back in the centre, or they may be benches without backs, or single seats, such as chairs or stools. All fixed seats, whether on the lawn or on gravel, to have foot-boards for the sake of aged persons and invalids. Round the central circle the seats should have stone backs, and a more architectural character than in any other part of the garden.

The flower-garden with its covered seat, the cottage in it with its public tea-room, and the ivied tool-house formerly attached to Mr. Strutt's kitchen-garden, are preserved; and also a large weeping ash with seats beneath, the branches of which have been trained into a regular form by iron rings.

In order to design the entrance lodges and gates, and the central statue, I called in the aid of Mr. E. B. Lamb, M.I.B.A., whose designs for the lodges and gates are shown in fig. 3, 4, and 5, and the ground plans of which are in accordance with Mr. Strutt's instructions in regard to public rooms, yards, and other accommodations. It may be added that the design of the garden will not be complete without an obelisk, or some such object, in the centre of the radiating circle in fig. 1; but this part of the plan is left to be completed by the committee of management.

As my instructions were to preserve as much as possible the belt and the trees in the interior of the ground already existing, I considered it most convenient to adopt the surrounding walk as a line of demarcation between the collection or arboretum in the interior of the grounds, and the miscellaneous assemblage in their circumference. Had the belt not existed, I should have extended the arboretum over the ground occupied by it, and thus have obtained room for a greater number of species, and a larger space for each individual tree and shrub. As things are, I have extended the belt in those places where it was wanting, and added to its interest by evergreen undergrowths, such as rhododendron, kalmia, laurustinus, box, holly, and mahonia; by low trees, such as arbor vitæ, red cedar, and cypress; and by large trees, such as cedar of Lebanon, silver fir, hemlock spruce, and evergreen oak. I have also introduced a collection of 100 different kinds of roses, all named; and placed the genera *U'lmus*, *Quércus*, *Pópulus*, and *Sàlix* in the new part of the belt, in order to give more room in the interior.

All the ground not covered by trees or shrubs I have directed to be laid down in grass to be kept closely mown; but round each tree and shrub forming the collection I have preserved a circular space, varying from 3 feet to 5 feet in diameter, which (with the hill in the centre, comprising one-third of the width of the circle, and on which the plant is placed) is not sown with grass, but is always to be kept clear of weeds. The use of this circle and little hill is to prevent the grass from injuring the roots of the trees while young, and to admit of the larger roots showing themselves above the surface, where they ramify from the stem, as before mentioned. It has been found since the garden was completed that these little hills have served as an effectual preservative of the plants; because, notwithstanding the many thousands of persons that visited the garden during the three days of the

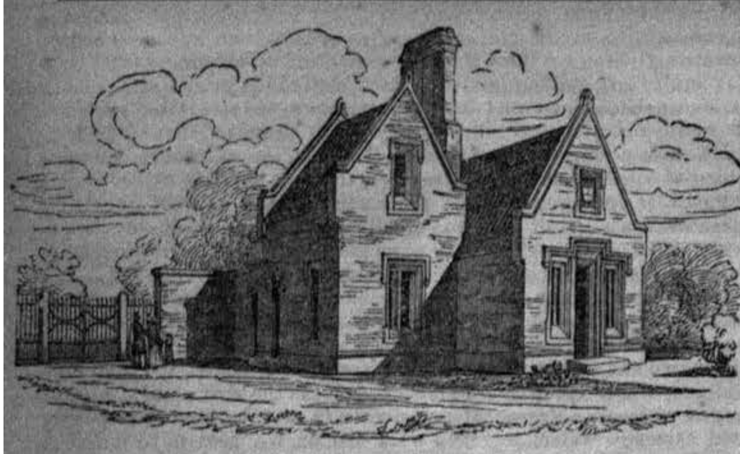


Fig. 5.—East Lodge of the Derby Arboretum, showing the Entrance Gates. Tudor Style, time of Henry VII.

ceremony of the opening, not a single plant was injured. Some few of the shrubs which require peat soil, such as the heaths, have had that soil prepared for them; and the genera *Cistus* and Heliánthemum, which are apt to damp off on a wet surface, are planted on a raised mass of dry rubbish, covered with stones. All the climbing plants have upright iron rods, with expanded umbrella-like tops, placed beside them; the lower end of the iron rod being leaded into a block of stone, and the stone set in mortar on brickwork, so that the upper surface of the stone appears 1 inch higher than the surrounding surface. This appearance of the stone above the surface is not only more architectural and artistical, but better adapted for the preservation of the iron at the point of its junction with the stone, than if the stone were buried in the soil.

With respect to the annual expense of keeping up the garden, it will be evident to those who have seen it, or who understand this description, that it will chiefly consist in mowing the grass in the summer season. As the extent of grassy surface to be mown will be reduced by the space occupied by the walks, and by the circles of earth on which there is no grass (on which the trees and shrubs stand, or which those in the belt cover entirely), to about six acres, one man will be sufficient to mow and sweep up this extent of lawn during the whole summer; the daily space to mow being about half an acre, and the grass mown to be distributed over the naked circles on which the trees and shrubs stand. All the other work which will require to be done in the garden during summer, such as weeding the walks, rolling them, weeding the circles on which the trees and shrubs stand, picking off insects from the plants, watering the ground with lime water where worm-casts appear, wiping the seats every morning so as to remove the excrement of birds, or whatever leaves or other matters may drop from the branches of the trees over them, &c. &c., may be accomplished by a second labourer. The head gardener or curator may manage the flower-garden and the vases of flowers at the junctions of the walks, and see that the company who walk in the garden do not injure the plants, &c.

During the winter season, or from December 1, to May 1, more than one labourer in addition to the head gardener will be unnecessary. The second labourer may at that season, therefore, be allowed to retain his house, and seek for labour elsewhere; and the saving thus made, it is presumed, would be a contribution towards the purchase, from some of the Derby nurserymen or florists, of all the flowers or other plants that may become necessary to fill the vases from May till October. Unless some arrangement of this sort be made, it will be impossible to do justice to the plan of exhibiting plants in the vases; because the flower-garden, if made a source of supply, would be injured in appearance; and to have a reserve garden, with a green-house or pit, would involve much more expense than hiring the plants from a nurseryman, and would be far from attaining the object in view so effectually. On the supposition that there were fifty vases, there would then be fifty different kinds of named flowers or green-house plants in them every day during the summer; and supposing that these kinds were changed once a week, and the same kind not repeated more than once in the same season, there would then have been upwards of 500 different kinds of handsome plants, with their names attached, exhibited to the public in the course of a single year. To give an idea of what these plants might be, I shall suppose them to consist of 200 showy hardy and tender annuals, 100 dwarf dahlias, 100 choice herbaceous plants, 100 geraniums, 100 Australian plants, 50 heaths, and 50 miscellaneous green-house plants, including fuchsias, cacti, aloes, &c. One great use of these plants is, by their bright red, yellow, orange, or white colours, to relieve the eye, and form a contrast to the green of the foliage and grass with which they are surrounded on every side. A similar contrast will be obtained by the colours of the dresses and countenances of persons walking in the A boretum.

The plan of the Arboretum was made in May, 1839; and, being approved of by Mr. Strutt, as soon as the crop of hay was removed from the ground, in the July following, the work was commenced by Mr. Tomlinson, a contractor for ground work, who laid out the walks, made the drains, and raised the general masses of the mounds. The mounds were afterwards moulded into suitable shapes, and connected by concave sides and lateral ridges with the surrounding surface, under the direction of my assistant, Mr. Rauch, who also superintended the planting of all the trees and shrubs, and all the other details connected with the ground, till the completion of the whole in September, 1840. The trees and shrubs were supplied chiefly by Messrs. Whitley and Osborn, but partly also by Mr. Masters of Canterbury; and the miscellaneous collection of roses was furnished by Mr. Rivers of Sawbridgeworth; the mistletoe was supplied by Mr. Godsall of Hereford; and some species, which could not be procured in the nurseries, were obtained from the Horticultural Society's Garden. The lodges and pavilions were designed by Mr. Lamb, as already mentioned: the north, or main, lodge in the Elizabethan style; the east lodge in the Tudor style, and in that variety of this style which was prevalent in the time of Henry VII.; and the pavilions in the style of James I. They were all built by Mr. Thompson of Derby; and the gates to the north, or principal, lodge were cast from Mr. Lamb's designs by Messrs. Marshall, Barber, and Co., of Derby.

ARCHITECTURAL COMPETITION.

SIR—The spirited manner in which you acted respecting the proceedings of the Gresham Committee in their attempt to extort the sum of one pound from architects desirous of competing for the Royal Exchange, and for which you received a vote of thanks from the Manchester Architectural Society, in which I (being a member) heartily concurred, has induced me to forward you the enclosed advertisement, which appeared in the Times newspaper, in compliance with which I wrote to the Vicar for the necessary particulars, and received in answer the accompanying note, by which it appears that the Vicar and Churchwardens are following the notable example of the Gresham Committee. Surely if the demand of twenty shillings for the necessary instructions was an extortionate act of the Gresham Committee, how much more so is the same demand in this case, where even the successful competitor is only to receive his commission upon £1,000, instead of the much larger sum at stake in the case of the Royal Exchange.

I leave you to comment upon this subject (should you think it worth notice in your valuable Journal), in any way you deem proper, but I think you will agree with me that the practice of charging architects *anything*, be the sum either large or small, for the instructions necessary in the preparation of competition designs, is very impolitic and reprehensible, and one that ought to be most strongly protested against by the profession.

The loss of time and expense architects must necessarily incur one would imagine quite sufficient for the most exacting Committee, without having new burdens continually heaped upon them.

I am, Sir,

AN OCCASIONAL COMPETITOR.

February 8, 1841.

The following is the advertisement and letter referred to by our correspondent:—"Architects desirous of submitting plans for the new pewing of the church of Fordingbridge, Hants, may apply to the Vicar and Churchwardens of Fordingbridge, until the 16th day of January next."

"The Vicar and Churchwardens in reply to A. B.'s letter, beg to inform him that the plans for repewing the Church of Fordingbridge, must be sent in by the 26th of February, and be in strict accordance with the instructions of the Church Building Society, but the estimate must not exceed £1,000.

"A lithographic ground plan is now ready to be forwarded on the remittance of a Post-office order for £1.

"A motto must be inscribed on the plan, and also a sealed letter enclosing the name of the candidate."

Fordingbridge, Jan. 20, 1841.

EPISODES OF PLAN.

"*Tædet quotidianarum harum formarum.*"

THAT there should be any thing at all novel in our manner of treating the subject we have chosen,—that the same idea should not have presented itself to others, and have been frequently adopted and carried out in publications bearing upon the particular branch of architectural study towards which this series will, we trust be found to contribute something fresh,—that such should be the case causes us no small surprise. Yet that we have not been anticipated in our present task by any one else, we may venture to affirm with tolerable confidence, since in none of the architectural works, either English or Foreign, we have seen—and our acquaintance with them is tolerably extensive—have we ever met with any studies of the kind we here purpose bringing forward. Nay the subject itself, as regards *Plan* generally, is almost invariably passed over without the slightest remark of any kind, as if either it were altogether unimportant in respect to design, contrivance, and effect; or as if the merits and defects, the advantages or disadvantages arising out of it were so exceedingly obvious to every one as to render it quite unnecessary to call attention to circumstances of that kind. In regard to Plans it is thought quite sufficient to give the mere explanatory *references* to them, without any thing farther even in the way of descriptive remark; much less are they ever accompanied by any thing like critical examination and comment. The Vitruvius Britannicus and similar works are so far altogether dumb books to the student, leaving him entirely to his own discernment and application, without even so much as putting him in the way of properly and profitably exercising them.

For this neglect of what deserves quite as much attention as almost any thing else in architecture, the only excuse that can be alleged—and a most unsatisfactory and provoking excuse it is—is that the plans themselves are so exceedingly common-place and insipid as scarcely to afford any matter at all for remark. We can learn from them the number and dimensions of the rooms, and beyond that there is very rarely any thing whatever in a plan that claims particular notice; for scarcely ever do we meet with a single piquant and *effectful* Episode. As seldom, too, do we find aught very original or particularly happy in the general combination—in what may be called the *laying out* of a building, generally. Instead of perceiving diligent study in this respect, we far more frequently detect—or rather, are struck by defects that seem to have originated in sheer negligence and inattention, they being such as could hardly ever have been suffered to pass, had the drawings been duly revised and reconsidered for the purpose of ascertaining whether they were susceptible of improvement. Laugier's remarks as to the extreme importance and value of Plan, are so excellent that they ought to be written in letters of gold, and hung up in every school of architecture,—certainly to be noticed in every elementary course of the study; and yet the advice they contain is either unknown or disregarded, which circumstance is rather a discouraging one to ourselves, inasmuch as it indicates what little attention is paid to, or interest is taken in what we have here selected as our subject.

Another writer, Milizia, reproaches architects with the monotonousness of their plans, and with scarcely ever deviating from the most "quotidian forms." With here and there a solitary exception, as he remarks, all our rooms—the most sumptuous as well as the most ordinary ones—are rectangular both in plan and profile; that is, are spaces enclosed only by four walls, and covered by a flat ceiling; consequently variety is reduced to little more than that which can be obtained by means of size and proportion, in regard to which there can be comparatively little difference in any suite of principal apartments in a house. For diversity of character, therefore, rooms are, in general, made to depend solely upon fitting-up, decoration, and furniture—matters which, as usually managed, are hardly considered to belong to the architect's province at all. In regard to what is strictly understood by the architecture of a room, variety of design seldom extends beyond what may be called mere *pattern;* the general forms being in every case the same, let them differ as they may in regard to detail. We are far from denying that considerable difference of character is attainable even according to the usual practice; but then it is obvious that such difference might be increased in geometrical ratio, by adopting forms that would lead to an infinity of combinations.

The system hitherto pursued in laying out—not ordinary houses, but mansions where we might expect to meet with all the graces of interior architecture, is calculated to produce only the minimum of effect; and what little effect it admits of is generally misplaced, being bestowed not on the apartments themselves, but merely on the approach to them. Far more frequently than not, such parts as entrance halls and staircases are both more spacious and more striking—both more architectural and more picturesque than any others; and in comparison with them, the rooms to which they lead, seem quite commonplace—not to say insignificant.* The consequence is, a most unfortunate anti-climax. That the first coup d'œil on entering should be a favourable one, and impressive in itself, we readily grant; still what is so shown should be treated as only preparatory—as something intended to excite curiosity, and not as a magnificent promise followed by non-performance and disappointment. There ought at least to be something of equal value kept in reserve, so as, at any rate to keep up a balance, if no more; whereas the contrary mode may not inaptly be described as a sort of bathos in architectural composition,—as the reverse of a *crescendo* effect,—as a most disagreeable and provoking, because disappointing, hysteron-proteron.

Before proceeding further, it may be as well fairly to meet, knock down, and put *hors de combat* at once those objections which, we foresee, are likely to be brought against the system we ourselves advocate, unless we can show that so far from having overlooked, we have considered, and are prepared to meet them. In the first place it may be urged with some degree of plausibility that if the kind of monotony and sameness which, together with Milizia, we hold to be a defect, were really felt to be such, and on the other hand, the picturesqueness and variety arising out of circumstances of plan and section, were positive merits, pains would be taken to secure the latter, and avoid the former. To this we reply; the constant repetition of the same hackneyed, commonplace forms is looked upon as matter of course: people in general are quite reconciled to it, because they neither look for, nor have any idea of what may be produced by a different mode of treatment. Besides which, the defect is rather negative than positive: a room is not faulty because it is "*quotidian*" in form, and there is nothing particular in it as to design, or that distinguishes it from a thousand others; the fault complained of is, that by confining ourselves to a single idea, as it were, we completely forfeit all those varied effects of which we might avail ourselves. Nor can it be said that the architectural picturesqueness arising out of plan, and general arrangement, is not worth the study it demands, because we have ever found that where it has been produced, it has always struck every one, and made a far greater impression upon them, than mere decoration, however costly. Granting that nothing whatever is gained by it in point of convenience, comfort, or accommodation,—and that a room of the most ordinary shape may be fitted up and furnished quite as splendidly as one which is striking on account of its architectural design;—what then? if any argument against our view of the case is to be derived from that, it may be extended so as to be applied with equal propriety against beauty of proportions in a room, for neither does that conduce to convenience or comfort, nor does the want of it prevent display being made in decoration and furniture.

It will be said, however, that such unusual—or as they will be called very *out-of-the-way* forms as are some of those we intend to bring forward in the course of the present Essay, would be found expensive in execution—perhaps be attended with loss of space, and would hardly admit of being applied without sacrificing other parts of the plan. That they would be more expensive is not disputed: therefore where economy is to be consulted quite as much—if not more than effect, they are of course out of the question; yet on that account they are no more open to censure or cavilling, than porticoes and many other things in architecture, which being of no positive—at least of no urgent utility, may be dispensed with where their cost becomes a serious consideration. It may further be frankly conceded on our part, that to introduce into a plan such features as our Episodes, would demand much more study and contrivance than is required when all that is to be done is to divide it into a given number of squares or parallelograms for the different rooms. To those who complacently satisfy themselves with doing that, and who consider any thing further no better than superfluous *trouble*, no ideas but those of "quotidian" routine are likely to present themselves, let the opportunity for introducing others be as favourable as it may. Hence, we rarely meet with any novelty—or aught striking, in regard to the plan, except in peculiar and obstinate cases, where, owing to local difficulties or other circumstances, the architect has been obliged to humour them, and has thereby been actually compelled to deviate from the ordinary track, and adopt by way of expedient what he would neither have done nor thought of doing, through choice.† Without premeditation, and being brought

* We were lately consulted as to a plan for a very extensive mansion about to be erected, where, on immediately entering the house the visitor sees before him a grand architectural vista of about 300 feet in length,—a most imposing display, no doubt, but produced at the cost of all the rest, for all the rooms would appear little better than cabinets in comparison with it. We accordingly suggested that it would be an improvement, to make a moderate sized entrance vestibule, and reserve the other part as a grand gallery coming at the termination of the suite of reception and drawing rooms.

† It may very fairly be questioned whether the interior of Windsor Castle

in for the *nonce*, unusual forms and arrangements are not at all likely to present themselves;—yet a single idea of the kind once adopted readily suggests a second and a third; for the combinations thus to be produced are so illimitable, that the chief perplexity is to decide which of them deserve the preference.

Occasionally, indeed, one meets with plans intended to display novelty and ingenuity, but then so far from being calculated to prepossess in favour of their forms and arrangements, they are seldom better than mere architectural *capriccios*, compounded of extravagant and absurd whims,—merely oddities, in which but little regard is paid either to effect or convenience, consequently they chiefly serve to bring every thing of the kind into discredit, and to confirm the prejudice in favour of common-place routine. Novelty alone will not suffice: there must also be something that will preserve its freshness and will continue to charm when the interest occasioned by novelty shall have worn away.

We are aware there are some who affect to despise any thing like contrivance or scenic effect in architecture, as beneath the dignity of the art—as partaking of stage trickery—as liable to be paltry. They insist upon simplicity, and nothing but simplicity, as if picturesqueness and complexity were never to be admitted, but banished altogether as faults. "Intricate forms, in works of architecture," Professor Hosking tells us, "whether *internally* or externally, will be found unpleasing:" and undoubtedly he is right, if he means no more than to censure that degree of intricacy which becomes confusion—a perplexed architectural jumble that wearies the eye by presenting no one distinct picture, instead of presenting a series of them—all varied, yet all agreeable in themselves and skilfully combined. Most certainly it is not easy to draw a precise line between what is an allowable species of intricacy, and what becomes a faulty excess of it. Yet if no positive rules can be laid down in regard to that quality in architecture, neither can it be done in regard to simplicity, which is apt to be carried so far that it becomes nothing better than poverty, baldness, monotony and insipidity. This is a misfortune which must be patiently submitted to; though, for our own part, we question its being one at all; since there would be small merit in going right, if it were impossible to go astray; nor would, we apprehend, the dignity of art be consulted by reducing art to such a system of exact rules for every possible occasion and contingency, that it might be learnt by rote. Of mechanical rote and routine there is by far too much in architecture already. It is true routine must be learnt and gone through; yet that is no reason wherefore we should confine ourselves to it without endeavouring to get a step beyond it. Rules are excellent leading-strings for beginners, yet little better than shackles to the more advanced artist.

(To be continued.)

CANDIDUS'S NOTE-BOOK.

FASCICULUS XXIV.

"I must have liberty
Withal, as large a charter as the winds,
To blow on whom I please."

I. THE terms in which they are sometimes spoken of, might lead those who had never seen them, to imagine that our London Squares possessed a high degree of positive architectural beauty, or at least were strikingly picturesque; neither of which is by any means the case. To apply, as has been done before now, the epithet "magnificent" to them, might almost pass for malicious, sneering irony, did we not know that if not bestowed, out of serious conviction, it is at least intended to be understood in earnest;—and such prodigality of praise, most certainly costs the dealers in "flummery" description nothing, it being just as easy to write the word "magnificent" as any other. The sober truth is, our Squares are very agreeable places of residence, and the houses in them are generally of a superior kind to others in their neighbourhood; they are more pleasantly situated, enjoy more light and air, and also a comparative degree of quietness. But as to architectural effect of any kind, that must not be looked for, there being no more in the elevations which form such *places* than in the sides of the streets of private houses, which lead into them. Here and there, it is true, there may be a front which possesses greater pretensions than its neighbours; but the same may occur in any other range of houses. Our Squares have an air of opulence and comfort, that is not to be mistaken; but they are quite in architectural undress, certainly *not* in gala costume,—in superfine broad-cloth, if you will, yet as plain and homely in cut, as if it were drugget. Now we do not say that this is wrong,—on the contrary, we hold such unpretending plainness to be more respectable than tawdry vulgar finery: all we wish is to call things by the right names, and not to talk of "magnificence" where it exists no more than in the garb of a Quaker. Let us leave to such persons as George Robins the humbugging practice of *dignifying* ordinary things by superfine words, unless we choose to be at the trouble of inventing other commendatory epithets to supersede the present hackneyed ones; for at present, those of "magnificent," "grand," "elegant," &c., are so bandied about on every paltry occasion that they have lost all force and meaning, and are in no better repute than the term "respectable." In honest truth, if we look at them with an architectural eye, the character of our Squares is only insipidity. They present neither the charm of piquant variety and contrast, nor that of unity of design. They are nothing more than four ranges of buildings surrounding an open space with a garden in its centre; consequently the *totality* of the design—supposing there to be any design at all—is lost, because the correspondence existing between those separate elevations is hardly distinguishable to the eye. Belgrave Square forms no exception, for even there, owing to the size of the area or *place* itself, the houses—which, by the by, are far from being in the most dignified style, or very best taste—appear low by comparison with it. The elevations produce no collective effect:—the four make no greater architectural impression than a single one of them would do in the same situation; while, on the other hand, if each is considered by itself as a single separate façade, it is very unsatisfactory, because there also we find proportion disregarded, and all grandeur nullified by the multiplicity of small parts.

II. Except what is called the Circus in Piccadilly, and in Oxford-street; and what is called the Polygon in Somer's Town, we have no instances of *places* that are rotund or polygonal in their plans,—none that are either hexagonal or octagonal, notwithstanding that those forms are well adapted for such purpose in themselves, and would create some variety in our street scenery. Upon a large scale the elliptic shape would be found applicable, and in such case the street might run through it in the direction of its transverse axis. An oval *place* of the exact dimensions of the Flavian Amphitheatre or Colosseum, viz. one whose axes should be 615 and 510 feet respectively, with a garden in the centre, of the size of the arena, would convey a better idea of the vastness of that monument, than Lincoln's Inn Fields do of the Great Pyramid. But to produce its full effect, no such place, be it an ellipse, circus, crescent, or polygon of any kind, should have its circumference broken by being pierced with streets running into it; for it ought to be entered through arches or gateways, over which the elevation should be continued. The Circus in Oxford-street, is no circus at all, but presents merely four segmental slices of one, separated from each other by exceedingly wide streets.

III. It may very fairly be suspected that the new Professor of Architecture at the Royal Academy is not at all likely to gain much credit by the remarks he threw out the other evening, in disparagement of Gothic Architecture. Most assuredly they did not betoken those enlarged and comprehensive views of art which ought to qualify one who fills so important and influential a post, and whose opinions will of course be received with implicit deference by many, and without further questioning or examination. On the contrary they were hardly worthy of a village pedagogue, much less of a Professor of the art. To adopt them, would be to retrograde instead of advancing,—to return to the now exploded prejudices against the Gothic style, which led such writers as Evelyn to condemn it as "a monkish and gloomy" mode of building, wherein no sort of harmony or correctness of proportions is observed! If the Professor be right, all we have been doing for the last forty or fifty years in regard to the study of Gothic architecture, has been worse than useless—positively naught and mischievous, seeing that the sooner we now unlearn it and retrace our steps, the better. It is a pity the Professor was not placed *in cathedra* a few years sooner, for in that case, we should probably have been spared the mortification of seeing the style denounced by him adopted for the new Houses of Parliament. It is further to be regretted that he did not think proper to explain himself by pointing out in detail the defects of the Gothic style *per se*, and what it is that renders it wholly inapplicable—at least unworthy of being applied, at the present day. By not doing so, he has afforded ill-natured people, the opportunity of saying that it was not in his power to support his opinion by aught of argument; consequently, that though it comes from a

would have had so many picturesque circumstances in its plan as at present, had its architect been employed to erect an entirely new structure, instead of altering and enlarging the old one. We doubt if, in that case, we should have had such unusual forms and combinations—such piquant *Episodes of Plan*, as the Library formed out of Queen Elizabeth's Gallery, the Waterloo Chamber, and the Breakfast Room at the angle of the two branches of the Grand Corridor.

Professor, it is no more than a bare opinion—a sweeping sentence of bigotted taste, put forth with authority, and seeking rather to silence contradiction than to convince. Fortunately such bigotry is perfectly harmless—likelier by far to excite ridicule, and laughter at the learned Professor's expense, than to prove mischievous by putting us out of conceit with Gothic architecture, and reviving the exploded half-witted prejudices against it. It is odd the Professor should not have seen this, and felt that if he touched upon the subject at all, it became him to do so boldly, that being the only effectual and proper course. At present, it looks as if he was fearful of saying too much,—that is, supposing him capable of vindicating his dogmas of taste. Vague assertion, even though it may proceed from a Professor, is but vague assertion after all; nor would it matter a single straw of itself, were it not that many receive it without further inquiry as an authorative *ipse dixit*, against which there is no appeal:—not however, that such is likely to be the case in the present instance, for we believe that the majority of the Professor's auditors were disposed to contradict him point blank. Mr. Grellier, who fancies "one man's Gothic is quite as good as another's," and one or two others may probably rejoice at finding the taste for Gothic architecture reprobated *ex cathedrâ* at the Royal Academy; but should the matter come to the ears of Mr. Welby Pugin, he will perhaps take up his cudgels again, and flourish them so stoutly as to make the poor Professor cry out "*peccavi.*" Now had the Professor manfully thrown down the gauntlet to Pugin, by formally controverting all that the latter has urged in favour of the Gothic style, it would have been doing something—would have been consistent and to the point. But what avails it to let off a puny little fizgig of a squib against Gothic architecture, instead of battering down the rampart of prejudices by which it is now defended? It is like attempting to knock down a citadel with a popgun.

IV. I frankly confess I do not at all comprehend Mr. Rooke's *sublimities*, nor can I make out what is the standard of Architectural Beauty to which he would refer us. However it is to be hoped that all are not so dull as myself, and will therefore be able to understand and turn to account what seems to have been dictated by the Great Sphynx herself. All that I can gather from his long rigmarole of words is, that Mr. Rooke not only admires, but actually venerates Gothic Architecture, and is therefore not likely to venerate such decriers of it as the present Professor of Architecture, and Mr. Grellier. Let Rooke then take the Professor to task, for it is certain that if he can neither convince nor convert him, he will fairly bamboozle him,—unless the Professor be Œdipus himself.

V. It is to be regretted that we have scarcely any documents at all to assist in studying or forming an acquaintance with the modern architecture of Spain and Portugal. In general, I suspect, it is but in very indifferent taste; nevertheless there must be something worth notice, if only as specimens of the national style. The Spanish and Portuguese architects, however, appear never to have published any of their designs, nor has that task been undertaken for them by foreigners —by any of those artists who have of late years afforded as tasteful studies of Italian and Sicilian architecture. Without going further, there must surely be enough at Madrid alone, to furnish materials for such a work as Gauthier's on Genoa, or Grandjean and Famin's Architecture Toscane.

THE ARCHITECTURE OF LIVERPOOL.

Sir—Having once undertaken to reply to the criticisms of your correspondent Eder on the above subject, I hope, since he has proceeded with his remarks, that you will again favour me with a portion of your space for the continuation of my rejoinder. I wish it may be understood that I pursue this system of counter-criticism from no love of controversy, but with a view to setting the architectural merits of the buildings noticed in their true light, so far as my poor ability may extend. It appears to me that your correspondent often overlooks the leading defects of the buildings he criticises, and expends his severity on their minor, though, perhaps, to the generality of observers, more obvious faults; and on the other hand, sometimes withholds all praise where much is really deserved. In speaking of the Royal Bank Buildings, he exclaims against the extravagant use of ornament in certain parts, but says nothing of its uniform coarseness of design, and utter want of meaning and character. He condemns the height of the basement and balustrade in the street front, but seems not to have observed, and a most singular oversight it is for an architectural student, that the front of the Bank itself facing the court, is composed of a Grecian Doric, and Ionic order, one above the other, and with so ærostyle an amount of intercolumniation, that I could not forbear laughing outright on my first encounter of its mirth-provoking visage; but reflecting that some £30,000 had been expended in producing all this tawdry deformity, I acknowledged to myself that, like Bottom's comedy, this was "very tragical mirth." The Venetian windows on the ground floor of the street front, consist of a little bit of Grecian Doric entablature with two columns and antæ, set on a sill which, with its burden, overhangs the wall beneath it, like that of an ordinary brick house. But enough of this most "original" edifice. Let us follow Eder to the Town Hall. He says it is "highly creditable for the day when it was executed," and in truth, nothing nearly so good has been executed in Liverpool since; it was originally designed by Wood, of Bath, though it has received later additions, (of the past generation,) which have in one or two respects improved it; still the original merit is his. When Eder condemned, with some justice, the carvings between the capitals, which, however, by no means obtrude themselves on the eye so as to become serious blemishes, he might, I think, as a set-off, have noticed the graceful well-conceived figure of Britannia by the late Charles Rossi, R.A., surmounting a cupola, which, though not adhering in its columnar arrangement to the strict rules of Grecian propriety, so often quoted and expatiated on by those who are utterly incapable of making any practical application of their principles, has the merit—and possibly, with deference be it said, the preferable one, in a structure in the Italian mode, and of its moderate dimensions—of a varied, picturesque outline, with perhaps some intricacy of form, but certainly much originality of design. It is, in fact, one of the most pleasing and characteristic features out of many which rear themselves above the ordinary buildings of the town. As regards the Railway station, we shall not materially differ, though I must observe that the capitals of the Corinthian columns are notoriously bad, whether the fault of the design or execution I know not; and that this ugly screen hides one of the best trussed roofs of a large span with which I am acquainted.

I cannot, nor I imagine could most persons, accede to the opinion that St. Luke's Church is a most successful attempt in the Gothic, or rather, the pointed style. The exterior is certainly fine in execution, of an excellent material, and often beautiful in detail; but as a whole, I confess I cannot admire it as some others do. Firstly it wants a clerestory, which gives an appearance of disproportionate height to the tower, and a want of importance and character to the body; and in the next place, the tower itself is far too much of a parallelogram, in which defect I think this church shares with its name-sake of Chelsea, arising, in both cases, from the use of octagonal turrets in lieu of buttresses, of which practice, as applied to a western tower, I have never seen an instance in which the effect was good. I do not extend this opinion to the central towers of cross churches, or Lincoln Cathedral would at once refute me; perhaps the western towers of the same edifice may be quoted against me; but be it remembered, that in this instance a screen wall extends north and south, and gives that air of stability to these towers which they would otherwise want. I must acknowledge they were never entirely satisfactory to me, even as they are. The fine colour of the stone and height of the tower, make this church a fine study for effects of ærial perspective: especially when the pinnacles and turrets of the body and chancel appear in front of the more distant tower in hazy weather; but while, in this respect, as well as a beautiful specimen of detail, and a fine piece of masonry, I admit the merits of this church to the full, I am of opinion that Mr. Gandy, to whom the design is ascribed, has failed to produce a striking example of the style. The want of a clerestory mars the effect of the interior, and the ceiling of the nave is quite out of character with those of the aisles. A rich wood roof was, it is said, designed for this church, but misdirected economy substituted one of lath and plaster. I can refer Eder to a modern church tower within three miles of Liverpool, which, though on a smaller scale and of an inferior material to this of St. Luke's, is equally good in detail, and in proportion and effect much superior. I allude to that lately added to the parish church of Walton, in which the architect, Mr. Broadbent of this town, has proved that he feels and has imbibed the true spirit of the style in which he worked.

Your correspondent next notices the North and South Wales Bank, in which he says the architect has encountered and overcome "enormous difficulties." Now really I must be permitted to say that I think the difficulties had the best of the battle. The ground is contracted for the accommodation required, and to mend the matter, the architect employs pilasters and columns 3 ft. 6 in. in diameter, and of a proportionate projection, which, with the space required for their bases, must reduce the ground some 2 feet and more in width; and, except the space allowed near the entrance for a most inconvenient winding-stair on one side, and a similar space, but how occupied I know not, on the other, must contract it about 5 feet in length. Again, the building is required to be very lofty in proportion to its extent, and we find an order without an attic employed, although the longest side

of the edifice presents nearly a square in elevation, and the shorter about a square and two-thirds in height. Further, the ground is irregular in form; and a pediment being placed over the narrow side, the obtuse angle on the one side, and the acute on the other, become most painfully obvious; while the wall within the columns, being kept at right angles to the long side, and therefore not parallel to its own line of front, quickly calls attention to the irregularity of the plan. The site is about 56 feet by 33, and the interpilastered spaces are two diameters or seven feet; the order, which nearly follows the proportion of the Jupiter Stator example, is raised on a plinth about four feet in height, which latter is pierced for the basement windows; there are three tiers of openings in the height of the order, and the whole exhibits the proportions indicated by the annexed sketches.

Fig. 1.—Front Elevation.

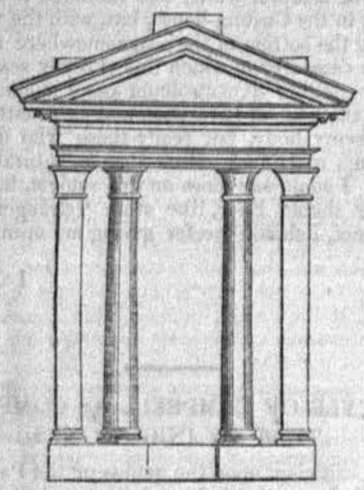
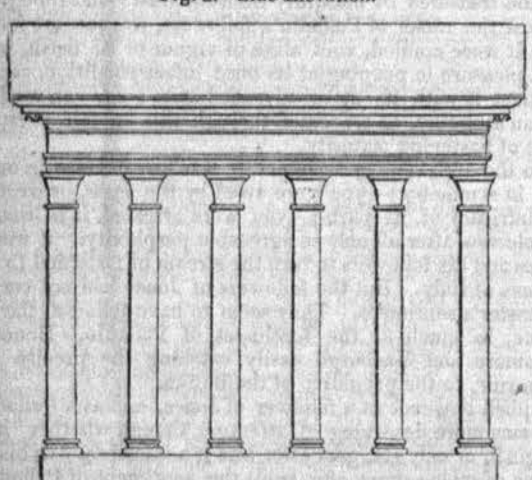


Fig. 2.—Side Elevation.



The effect in perspective may be conceived, and I ask whether excellence of detail could atone for such an outrage on architectural propriety and taste as a temple-form structure like this, with three stories in an order. This is an example of the effects of modern competition; where the successful architect, having had his design adopted in consequence, it is said, of his private interest in the committee of management, has not only the advantage, as was understood at the time, of examining those of his competitors, during the six weeks which elapsed between the decision of the committee and the return of the designs to their respective authors, but is permitted to expend about twice the amount to which they were, in the first instance, limited, and this for the purpose of producing a building which is a perfect burlesque on all correct proportion. The execution is creditable to the contractor, but in consequence of having a very poor plaster cast to work from, the capitals are not at all like those of the example professed to be followed. The Union Bank follows its Welsh neighbour in Eder's list. I readily admit the beauty of the Ionic columns, in which a leafy termination has been adopted for the flutes, somewhat in the manner of those in the columns of the monument of Lysicrates. The capitals of the antæ are also original and tasteful, and the bases of both, in which an inverted ovolo is used in place of the upper torus, are improvements on the common attic one; a similar base has been used by Mr. Foulston in the Plymouth theatre. Beyond these details I can discover nothing in this design at all commendable, nor bearing the least trace of the taste which seems to have dictated them. The pediment is filled entirely by the convolutions of an immense motto riband which Eder calls "bold;" would not impudent be a more applicable term? The honeysuckle in the frieze is stiff and ungraceful in the extreme, as are the carvings of foliage and tendrils which occupy part of the panel within the columns. Let any one spend an hour in looking over Stuart's Athens, or Inwood's Erechtheum, and then, walking to this bank, say how much of Grecian character any of these details exhibit. The ponderous truss which stops the cornice at the end next the adjoining building, has a most cast-iron air, as have also the windows of both floors, and the square sham balustrade above them. The lower windows have pediments above a frieze, which is separated from the architrave only by projecting about ⅛ of an inch beyond it; while the architrave itself has its moulding sunk on its inner margin, which may occasionally have a good effect in buildings of rustic or unornate character, but seems much at variance with the degree of enrichment which is affected in other parts of this building. The dressings of the small square windows above these I consider equally objectionable, for in them the *fillet* of the architrave alone is broken into knees on every side, while the moulding itself follows the line of the opening. This has a very paltry, poor effect. The pedestals which divide the balustrades into lengths are panelled, and the panels filled with flowers which bear a closer resemblance to tin tartlet moulds with a knob in the middle, than anything else I can think of. The carvings under the portico represent, I suppose, the ladies of the three kingdoms just after the round tea-table has been removed; with a background exhibiting a steam-carriage in full cry along a viaduct which appears to have no end, like the Irishman's rope, beneath which ships are to be seen afloat in something like scale armour. This piece of sculpture forms part of an amusing history. The panel of which it now occupies the centre, was originally filled with foliage and scroll work of similar character to that which now occupies its ends; and the "illustration" of the principle of union was intrusted to two feathered bipeds, who surmounted the pediment, and lugged, each with one foot, at the ends of a cord which encircled what was meant for a bundle of sticks, but bore more resemblance to part of a reeded column. These notable fowls were said to be of the liver or cormorant species; but were much more like, in their proportions and plumage, to the ancient effigy of the supposed fabulous dodo. Short was their reign in their exalted station: the Bank directors not, I suppose, feeling flattered by the constant grins and broad jests of the group of idle corn porters whom the novelty attracted to the opposite corner, and the less obstreperous mirth of the more polished passengers, deposed these eminent sea-birds, and substituted an acroterial honeysuckle closely conforming to the metallic rigidity of character exhibited by its brethren in the frieze, the foliage in the centre of the panel was cut away, the ladies above-mentioned soon made their debût, and no doubt will enjoy a more permanent occupation than their less fortunate predecessors. In closing my remarks on this building, I must observe that, though the stone of which it is built is excellent, and the execution likewise particularly good, the general effect is far from agreeable, there being an angularity and hardness in the details, and a general harshness of outline, which convey an impression of repulsive coldness, and cause an entire want of that attractive lively air which many buildings possess, without at all detracting from that substantiality of expression which should characterize a place of business, and most of all, a Bank. In closing my subject for the present, I can assure Eder, that as regards the Branch Bank of England, I had rather have the credit of designing its street front than the whole of the three joint stock banks he has noticed.

I should have observed, with regard to the Union Bank, that it lays claim to being a complete example of Greek character. I have no hesitation in saying, that beyond the columns and antæ there is not the least ground for such pretensions; but on the contrary, that in common with other buildings affecting Grecian details in this town—with the exception of the pretty little model of the temple of Jupiter Panhellenius, which stands above what was once a most picturesque stone quarry, but has since been spoiled into St. James's Cemetery—it is a glaring example of the inapplicability of that style to ordinary modern uses, showing how completely its unity and simplicity of character are destroyed when more than one height of openings is required, and how impossible it is, by pretending to preserve the details in mouldings, and (save the mark!) in ornament, to overcome the difference of expression which this and other equally wide departures from ancient practice produce in the whole. Moreover, the frequent fractures which mar the entablatures of our Anglo-Grecian buildings

should teach us how unfit the common building-stones of this country are for the long bearings and great superincumbent weights which the use of this style imposes on us, but for which the Greek marbles were so eminently adapted. The assumption which some have endeavoured to maintain, that the architects of Greece confined themselves to horizontal composition on account of the superior grandeur of effect which could be so produced, is sufficiently refuted by our own magnificent cathedrals; and I am myself convinced that, had the principle of the arch been known to them, and the almost illimitable power which the architect, by its means, obtains over his materials, none would more fully have availed themselves of its aid than these great masters in science and art. I am aware that I am liable to the charge of reviving truisms; but there are architects who seek to conceal their own dullness under an affectation of enthusiastic admiration of the style of ancient Greece; who abandon and pretend to despise the use of the arch in their designs, because it was unknown to, and consequently unused by, the Greeks, and thus produce buildings which can never be otherwise than unsubstantial and insecure, because constructed of materials unfit for the practice of the style which they affect to follow. I remarked in speaking of the Custom House, that fractures were visible in the stone-work, which I could only attribute to a settlement in the foundations. I have since been confirmed in this opinion, by observing seven or eight similar fractures, particularly in the south and south-western parts of the building, some of a most serious and threatening aspect; thus this extensive and costly pile will, probably ere long, require, like its prototype in London, a repair almost as expensive as its first erection. But to return to the banks. Having disposed of the principal joint stock banking-houses, Eder attacks, without mercy, the building in which the branch business of the Bank of England is conducted. Of the interior of this bank I know but little, and any apparent want of convenience may be perhaps sufficiently accounted for by the fact of its having been originally a private dwelling-house. With respect to the exterior, however, I can assure you and your readers, Mr. Editor, that it is one of the most pleasing street fronts which the town contains. It is of Italian character, exhibiting a Corinthian pilastral order of five intercolumns on a solid basement, with two stories in the height of the order, and an attic above it. The wall between the pilasters and the attic piers, as well as that of the basement is rusticated throughout. The ground floor windows have no other decoration than their moulded cills, and the centre opening, which till very lately was occupied by the door, has the only pediment in the façade, supported on bold trusses. The cills of the one pair windows are lighter and more decorative in character than those of the ground floor, beside being supported by trusses of varied detail and pleasing design, from which festoons of fruit and flowers descend towards the heads of the ground floor openings. The attic is perhaps too high for the order it surmounts, but not more so than is the case in many well known buildings; Greenwich Hospital for example; and the narrowness of the street, and the projection of the cornice almost neutralize this defect. The festoons are well designed and executed, and harmonize with the decorative character of the Corinthian order employed, as does also, in my opinion, the rusticated surface of the intermediate masonry. I do not know the date of this house, nor the name of its designer, but should think it must date some 80 years back; at all events it does credit to his taste, and I am certain that most persons making any pretensions to architectural taste would agree with me that it is much to be preferred before any of the modern banks which have been noticed by Eder. The removal of the door from its proper place in the centre, to the meagre Roman Doric porch beyond the line of front, has injured the unity of the composition, and the subsequent scraping of the stone-work has given it all the rawness of a newly finished building, without its sharpness of detail. In closing my remarks on this bank I cannot but express my astonishment at, and pity for, the *taste* which could find so much to admire in the tortured and unnatural decorations of the Union Bank, in the misproportion and coarseness of the Welsh, and consign the Branch Bank to such unqualified reprobation.

The markets next engage the attention of your correspondent. He commends the fish market as well adapted to its purpose, which may be the case now, but certainly was not until the fish-fags rose en masse, and with sundry threats of violence to the architect, demanded and obtained the admission of light in the side walls. St. John's market is capable of fine effects of light certainly, in consequence of its great extent, which on plan is about the same as York Minster, but other merit I cannot discover in it, and the construction of the roof is of the most ordinary and journeyman-like description. In referring to St. James's cemetery I was reminded of the circular structure in which Gibson's beautiful statue of Huskisson is immolated. Independently of the absurdity of setting an eight foot statue in a place not twice that height in diameter, the thing is in itself most ungraceful. I am perhaps forestalling Eder, but he must excuse me. Adopting the details of the Tivoli example of the Corinthian order, the architect appears to have aimed at a mean between the proportions of the temple to which it belongs, and the well known monument of Lysicrates. The result is, that the proportions are neither those of horizontal composition like the temple of Tivoli, nor of vertical, like those of the little monument named. Perhaps habit has given these two ancient examples almost the authority of rule as to the proportions of circular buildings in the classic styles. At all events the medium here attempted is a complete failure, and Bramante's little temple of St. Peter in Montorio, might have given the architect a hint that a varied outline might be preferable to a severe one in so small a building. The terminal which crowns the cupola is far from redeeming the other defects of the design. The enormity of burying so fine a work of art as Gibson's statue in a coop like this, is the more to be regretted, as another by the same eminent sculptor which was intended to occupy the centre of the long room in the Custom-house, has, with the vessel which contained it, gone to the bottom of the sea, somewhere near the mouth of the Tiber. The cemetery in which this (I really scarce know what to call it, for it is neither a mausoleum nor a monument), statue-box stands as one of the lions of Liverpool, and as a matter of course *must* be admired by every body, but really those who do so must prefer seeing animals in a reclaimed rather than a natural state, for it is a very tame lion. I could say more on this subject, but shall refrain for the present; for should Eder, like other "strangers," launch out in admiration thereof, I should prefer giving my opinion in the form of a reply to his.

I am, Sir,
Yours, &c.,
H.

Liverpool,
Jan 22nd, 1841.

ON THE STYLE OF CAMPBELL AS COMPARED WITH THAT OF INIGO JONES.

In pursuing a criticism upon the genius of the Palladian school, the excuse rests chiefly on the influence its pupils have had upon the growth of classic beauty, and on the exertions they have made to rescue the treasures of antiquity from the dust: and though, in looking amidst the ranks of Palladio's followers, we see art for a second time as it were cradled, void alike of vigour or of finish, we cannot but feel pleasure in peeping at its once infant condition, especially as we contrast it with its more advanced state: nor can we feel otherwise than sanguine, as we catch through this in fair perspective its promise of hastening maturity.

Up to the 16th century architecture was less definite in outline, less studied in symmetry;—you were awed by the mass, or were charmed by the intricacy of its parts;—you were arrested, it is true, but then the whole was after all only an agreeable perplexity. It was reserved for Jones and his followers to turn the stream of taste and to transplant the graces of Italy. But the followers of Jones had not very much of their master's sentiment. They seem to have followed the fashion of the time, as much as the sentiment of Palladio. Hence we find Hawkesmore and Vanburgh easily catching the precise feeling of Grecian rule, to the prejudice of the Italian.

Campbell however as a follower of Jones, and as a Palladian architect, seems more deserving of attention, though whether he features the original, or only staggers after him is a question.—In his mansions, (so many of which grace our land) the sentiment of Palladio and the style of Jones seem both affected. Still you are conscious at the first glance of a stiffness in the design. You feel if an important part is to arrest that it becomes very often unpleasantly independent of the remainder; or if a change of features are successively to please, that you are not led to them by approaches sufficiently easy. The eye is not courted, it is forced.—Sudden changes too often occur from the horizontal to the vertical, in that part where altitude is the aim; and very often in the front a sudden depression of the sides, disuniting to a certain extent the centre from the rest, and destroying in a measure the harmony of relations by a want of unity. It seems as if the artist occasionally lept into his parts; as if notwithstanding his apparent study of every subordinate feature in the Pallatial style, and of the principles of Italian arrangement, the stiffness of the copy must remain, rather than the freedom of the original. It is true that you are looking at the design of a Palladian architect; that there are dispositions of the void and enriched, of the depressed and the elevated; that there are the same segmental and triangular windows in mutual relief; that balustrades crown the void, and that turrets, cupolas, columns, figures, &c. prevent you dwelling on the breadth: but then you see too much of a studied arrangement. You can almost detect the labours of the artist; you can almost discern the process by which the features of

his design are apportioned; you see the architect as much as his edifice. When he introduces ornament he makes you to revel very often in a part where the eye should not remain, or he encloses a free figure in some stiff panel and destroys its expression. The decoration is not such that the part would look bare without it, or that the proportion would become affected if it was not there. You see not as in Jones the ornament as identified *with* the mass, but only as a part of it. You detect too much of the hand which placed it there, and too little of its relation to surrounding objects.

Contrasting him with Jones whom he imitates, or with Palladio whom he affects, we at once see that his very study makes him miss the careless beauties of the former, whilst his caution prevents him soaring into the grand simplicity and rich excellence of the latter.

Campbell thus although of the Palladian school is only of such in its leading characteristics. That quick perception of grace and of beauty ever necessary to relieve the huge superficies is not his. His sensibilities seem dull upon the lesser auxiliaries, so useful to design. He is not grand in his comprehension, and yet at the same time minute in his care; or if he does descend to minuteness, he does not change from the greater to the less, from the grand to the inferior with the care of a genius, but creeps into his parts with the fear of a copyist. Finally, he seems to have wanted more quickness of apprehension, more fertility of thought, and more liveliness of fancy, to have in any way equalled his originals.

FREDERICK EAST.

February 10, 1841.

ST. LUKE'S CHURCH, CHEETHAM HILL.

SIR—Being a constant reader of your most valuable Journal, and knowing the great number of communications which must be forwarded to you for perusal, I appreciate the difficulty of the task you have to perform in selecting those which may best serve the two professions, the interests of which you so strenuously and successfully advocate. By way of apology for this communication, the following reasons may be deemed sufficient.

1st. I consider the design and execution of the edifice alluded to to be of such high excellence, that it is only doing a bare act of justice to the architect to whose genius we are indebted for this beautiful work of art, and also to the admirers of modern ecclesiastical architecture, to give a greater publicity to it than it has yet received, and

2ndly. Not having observed anything more than a casual notice of this edifice in your publication, I think a few descriptive remarks, even from an incompetent person, if given in sincerity, and with an eye to the advantage and improvement of the profession, would not be misapplied.

The church under consideration is advantageously situated in the township of Cheetham, on the main road from Manchester to Bury. The funds were raised by subscription, some of the principal residents in the neighbourhood being most liberal in their donations; it is erected from the design of J. W. Atkinson, Esq., architect, who has adopted the Gothic style most happily blending the late ornamental with the early perpendicular style. It is very simple in plan, the body of the church being divided by two rows of piers and arches into nave and aisles; there is a steeple at the west end, and an altar recess at the east, behind which is a large vestry. There are galleries in the aisles and at the west end. The roof of the nave is carried much higher than that of the aisles, so as to admit of clerestory windows.

The steeple consists of a tower and spire. The former has octagon turrets with buttresses at the angles, terminated with crocketted pinnacles. The lower compartment has a well proportioned and deeply recessed doorway, over which is a lofty perpendicular window, and at the sides are windows similar in style. The spandrils over the large window are filled with perpendicular tracery, in the centre of which is the clock. The belfry has two narrow windows on each side, and is crowned with a bold cornice and perforated battlement. The spire is crocketted at the angles, and beautifully connected with the tower by perforated flying buttresses springing from the pinnacles at the angles of the tower; it is finished with a belt and crocketted finial, surmounted by a cross, the emblem of Christianity.

The aisles are divided by buttresses and crocketted pinnacles into six compartments, each decorated with a lofty window; the clerestory has two windows to every one in the aisles, also divided by smaller buttresses and crocketted pinnacles. The nave terminates at the east end with octagon buttresses, and a lofty *side* window to light the altar recess. The east end is simple but original, having *no large east window*, but three well proportioned niches in its place. The ends of the aisles are finished with windows similar to those in the side, and buttresses at the angles.

The whole of the external detail, window dressings, cornices, &c., are good, plain, and effective, and it seems to have been the aim of the architect to obtain a good outline rather than any small frittered ornament, which is only gained at a great expense and trouble, to be lost sight of when viewed at a little distance.

On entering the churchyard from Manchester, the spectator has a S.W. view of the church, the tower standing boldly forward, and the pinnacles and flying buttresses which connect it with the spire giving a diversity of shadow which is most beautiful. The beauty of this view is somewhat lessened by the three large windows in the tower, which crowd it too much, and having only the octagon buttresses at each angle, they seem inadequate to support the weight of the belfry and spire; it is also a pity that the spire was not higher, as it does not harmonize with the beautiful proportion of the tower. At the east end you see the effect of the three niches, which are substituted for the great window.

From the tower you enter a vestibule under the gallery, which is divided from the body of the church by an ornamental glass screen. In the centre of the vestibule and opposite to the entrance door, is a handsome stone font, and on the right and left are doors which communicate with the gallery stairs as well as the body of the church. The altar is beautifully ornamented with perpendicular panels and niches, with richly ornamented canopies; it is lighted by side windows, which have a good effect. It is composed of two compartments, divided by a bold cornice, which runs underneath the side windows. The lower one consists of three Gothic panels with heads of tracery, in which are written the Creed, Commandments, and the Lord's Prayer; on one side of the altar table is a deeply recessed doorway to vestry, and on the other a false one to correspond. The side walls under windows are beautifully ornamented by a series of small arches, springing from isolated columns with foliated caps and bases, forming a sort of triforium. The top compartment consists of a large centre panel, which it is hoped will be fitted with some talented painting; on each side of this are niches and rich canopies; the plainness of the wall above this is hid by perpendicular panelling which reaches to the ceiling.

The pulpit, which is situated rather on one side of the altar, is quite exquisite. The base represents a rock, on which are seated statues of our Saviour and two Magdalens which support the pulpit, it being the medium through which the Gospel is propagated. On the other side of the altar is the reading desk, which is a large Gothic chair, with a stand for the books supported by an eagle; between it and the pulpit is a smaller chair for the clerk.

The organ screen is very beautiful, in the ornamental style, divided into three compartments by niches, canopies, &c., and crowned by three crocketted spires and pinnacles. The organ is a very good one, built by Hill of London, at an expense of about £600.

On entering the church from the west end, the eye is disagreeably affected by the west gallery projecting too far into the church, and cutting short the view of the altar piece; this, however, ceases when you get fairly into the church, and if viewed on a fine day, is very chaste and elegant. Turning round on reaching the altar, you have a view of the organ screen. It is to be regretted that it and the altar piece do not accord better as to style, for there is decidedly a want of unity in them when viewed as part of the same edifice.

I am happy in being able to state that the finishing and painting of this beautiful church was intrusted to the care of Mr. Atkinson, who seems to have spared no pains or trouble in fulfilling the arduous task imposed on him. The whole of the walls are tinted of a warm stone colour, the mouldings left white, and the most prominent members of them gilt, which gives it a most rich and mellow appearance. The ceiling over the nave is divided by the roof principals, and moulded ribs into square compartments, and these again painted in imitation of oak tracery and panels. The pews are painted to imitate grained oak, and lined with crimson moreen. There is accommodation for about fifteen hundred people.

The cost of the church I have not been able to ascertain. The design first determined on was to have been erected for about five thousand pounds, but when it was as forward as the window cills, it was altogether altered, and continued to be so until finished, so that it is now supposed to have cost from fourteen to fifteen thousand pounds.

Craving your indulgence for so lengthened and perhaps unprofessional a description of this interesting and beautiful church, and hoping that you may have an opportunity of testing the truth of my remarks by a personal view of it.

I remain, your obedient servant,

FRANK T. BELLHOUSE, *Architect.*

Grosvenor-square, Manchester,
February 9, 1841.

The formulæ in this Tables are designed to facilitate the computation of the strength and dimensions of Girders, Bressummers, Joists, and other horizontal supports. They are founded on the delicate and important experiments of the late Mr. Thomas Tredgold, combined with the laws of resistance as promulgated by Galileo, and afterwards corrected by Mariotte and Girard. The coefficients are adapted to cast iron of the specific gravity 7·372,* giving a weight of 460¾ lb. to the cubic foot, and they can easily be modified for other materials by simply reducing the tabular constants in the ratio of the specific cohesions, a table of which is subjoined.——Note: The results obtained by calculation are all within the limits of elasticity.

†l = the length of the beam in feet. m and n = the length of the segments of a beam loaded at some other point than the middle. $m+n=l$ the total length of the beam.

	Rectangular Beams.—Fig. 1.	w = the load in cwts.	b = AB the breadth in inches.	d = AC the depth in inches.	b = A B the breadth, and d = A C the depth in inches.
1	Fixed at one end and loaded at the other . . .	$lw = 1{\cdot}9\,bd^2$	$b = \frac{lw}{1{\cdot}9\,d^2}$	$d=\left(\frac{lw}{1{\cdot}9\,b}\right)^{\frac{1}{2}}$	
2	Fixed at one end and loaded uniformly over the length .	$lw = 3{\cdot}8\,bd^2$	$b = \frac{lw}{3{\cdot}8\,d^2}$	$d=\left(\frac{lw}{3{\cdot}8\,b}\right)^{\frac{1}{2}}$	
3	Supported at both ends and loaded at the middle . .	$lw = 7{\cdot}6\,bd^2$	$b = \frac{lw}{7{\cdot}6\,d^2}$	$d=\left(\frac{lw}{7.6\,b}\right)^{\frac{1}{2}}$	Fig. 1.
4	Supported at both ends and loaded uniformly over the length .	$lw = 15{\cdot}2\,bd^2$	$b = \frac{lw}{15{\cdot}2\,d^2}$	$d=\left(\frac{lw}{15{\cdot}2\,b}\right)^{\frac{1}{2}}$	
5	Fixed at both ends and loaded at the middle . . .	$lw = 11{\cdot}4\,bd^2$	$b = \frac{lw}{11{\cdot}4\,d^2}$	$d=\left(\frac{lw}{11{\cdot}4\,b}\right)^{\frac{1}{2}}$	
6	Fixed at both ends and loaded uniformly over the length .	$lw = 22{\cdot}8\,bd^2$	$b = \frac{lw}{22{\cdot}8\,d^2}$	$d=\left(\frac{lw}{22{\cdot}8\,b}\right)^{\frac{1}{2}}$	
7	Supported at both ends and loaded at some intermediate point	$mnw = 1{\cdot}9\,(m+n)\,bd^2$	$b = \frac{mnw}{1{\cdot}9\,(m+n)\,d^2}$	$d=\left(\frac{mnw}{1{\cdot}9\,(m+n)\,b}\right)^{\frac{1}{2}}$	
8	Fixed at both ends and loaded at some intermediate point .	$mmw = 2{\cdot}85\,(m+n)\,bd^2$	$b = \frac{2{\cdot}85\,(m+n)\,d^2}{mnw}$	$d=\left(\frac{mnw}{2{\cdot}85\,(m+n)\,b}\right)^{\frac{1}{2}}$	

	Open Beams.—Fig. 2.	w = the load in cwts.	b = AB the breadth in inches.	d = AE the depth in inches.	b = A B the breadth, d = A E the depth, and $p=\frac{\mathrm{CD}}{\mathrm{AE}}$
1	Fixed at one end and loaded at the other . . .	$lw=1{\cdot}9\,bd^2\,(1-p^3)$	$b=\frac{lw}{1{\cdot}9\,d^2\,(1-p^3)}$	$d=\left(\frac{lw}{1{\cdot}9\,b\,(1-p^3)}\right)^{\frac{1}{2}}$	
2	Fixed at one end and loaded uniformly over the length .	$lw=3{\cdot}8\,bd^2\,(1-p^3)$	$b=\frac{lw}{3{\cdot}8\,d^2\,(1-p^3)}$	$d=\left(\frac{lw}{3{\cdot}8\,b\,(1-p^3)}\right)^{\frac{1}{2}}$	Fig. 2.
3	Supported at both ends and loaded at the middle . .	$lw=7{\cdot}6\,bd^2\,(1-p^3)$	$b=\frac{lw}{7{\cdot}6\,d^2\,(1-p^3)}$	$d=\left(\frac{lw}{7{\cdot}6\,b\,(1-p^3)}\right)^{\frac{1}{2}}$	Transverse Section.
4	Supported at both ends and loaded uniformly over the length .	$lw=15{\cdot}2\,bd^2\,(1-p^3)$	$b=\frac{lw}{15{\cdot}2\,d^2\,(1-p^3)}$	$d=\left(\frac{lw}{15{\cdot}2\,b\,(1-p^3)}\right)^{\frac{1}{2}}$	
5	Fixed at both ends and loaded at the middle . . .	$lw=11{\cdot}4\,bd^2\,(1-p^3)$	$b=\frac{lw}{11{\cdot}4\,d^2\,(1-p^3)}$	$d=\left(\frac{lw}{11{\cdot}4\,b\,(1-p^3)}\right)^{\frac{1}{2}}$	
5	Fixed at both ends and loaded uniformly over the length .	$lw=22{\cdot}8\,bd^2\,(1-p^3)$	$b=\frac{lw}{22{\cdot}8\,d^2\,(1-p^3)}$	$d=\left(\frac{lw}{22{\cdot}8\,b\,(1-p^3)}\right)^{\frac{1}{2}}$	
7	Supported at both ends and loaded at some intermediate point	$mnw=1{\cdot}9\,bd^2\,(m+n)\,(1-p^3)$	$b=\frac{mnw}{1{\cdot}9\,d^2\,(m+n)\,(1-p^3)}$	$d=\left(\frac{mnw}{1{\cdot}9\,b\,(m+n)\,(1-p^3)}\right)^{\frac{1}{2}}$	
8	Fixed at both ends and loaded at some intermediate point .	$mnw=2{\cdot}85\,bd^2\,(m+n)\,(1-p^3)$	$b=\frac{mnw}{2{\cdot}85\,d^2\,(m+n)\,(1-p^3)}$	$d=\left(\frac{mnw}{2{\cdot}85\,b\,(m+n)\,(1-p^3)}\right)^{\frac{1}{2}}$	

* If the specimen under consideration be of different specific gravity from this, the calculated strength must be reduced in the same proportion.
† Divide by the length for the load in cwts., or divide by the weight in cwts. for the length in feet.

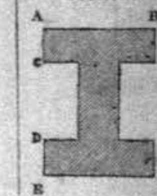
TABLES ON THE STRENGTH OF BEAMS.

	Grooved or Double Flanged Beams.—Fig. 3.	w = the load in cwts.	b = AB the breadth in inches.	d = AE the depth in inches.
1	Fixed at one end and loaded at the other . . .	$lw = 1{\cdot}9\, bd^2\,(1 - qp^3)$	$b = \frac{lw}{1{\cdot}9\, d^2\,(1 - qp^3)}$	$d = \left(\frac{lw}{1{\cdot}9\, b\,(1 - qp^3)}\right)^{\frac{1}{2}}$
2	Fixed at one end and loaded uniformly over the length .	$lw = 3{\cdot}8\, bd^2\,(1 - qp^3)$	$b = \frac{lw}{3{\cdot}8\, d^2\,(1 - qp^3)}$	$d = \left(\frac{lw}{3{\cdot}8\, b\,(1 - qp^3)}\right)^{\frac{1}{2}}$
3	Supported at both ends and loaded at the middle . .	$lw = 7{\cdot}6\, bd^2\,(1 - qp^3)$	$b = \frac{lw}{7{\cdot}6\, d^2\,(1 - qp^3)}$	$d = \left(\frac{lw}{7{\cdot}6\, b\,(1 - qp^3)}\right)^{\frac{1}{2}}$
4	Supported at both ends and loaded uniformly over the length .	$lw = 15.2\, bd^2\,(1 - qp^3)$	$b = \frac{lw}{15.2\, d^2\,(1 - qp^3)}$	$d = \left(\frac{lw}{15{\cdot}2\, b\,(1 - qp^3)}\right)^{\frac{1}{2}}$
5	Fixed at both ends and loaded at the middle . . .	$lw = 11{\cdot}4\, bd^2\,(1 - qp^3)$	$b = \frac{lw}{11{\cdot}4\, d^2\,(1 - qp^3)}$	$d = \left(\frac{lw}{11{\cdot}4\, b\,(1 - qp^3)}\right)^{\frac{1}{2}}$
6	Fixed at both ends and loaded uniformly over the length .	$lw = 22{\cdot}8\, bd^2\,(1 - qp^3)$	$b = \frac{lw}{22{\cdot}8\, d^2\,(1 - qp^3)}$	$d = \left(\frac{lw}{22{\cdot}8\, b\,(1 - bp^3)}\right)^{\frac{1}{2}}$
7	Supported at both ends and loaded at some intermediate point	$mnw = 1{\cdot}9\, bd^2\,(m+n)\,(1 - qp^3)$	$b = \frac{mnw}{1{\cdot}9\, d^2\,(m+n)\,(1 - qp^3)}$	$d = \left(\frac{mnw}{1{\cdot}9\, b\,(m+n)\,(1 - qp^3)}\right)^{\frac{1}{2}}$
8	Fixed at both ends and loaded at some intermediate point .	$mnw = 2{\cdot}85\, bd^2\,(m+n)\,(1 - qp^3)$	$b = \frac{mnw}{2{\cdot}85\, d^2\,(m+n)\,(1 - qp^3)}$	$d = \left(\frac{mnw}{2{\cdot}85\, b\,(m+n)\,(1 - qp^3)}\right)^{\frac{1}{2}}$

b = A B the breadth, d = A E the depth, $p = \frac{\text{CD}}{\text{AE}}$, and $q = \frac{2 \cdot \text{CF}}{\text{AB}}$.

Fig. 3.

Transverse Section.

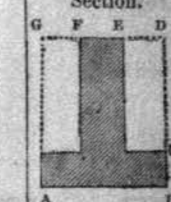


	Feathered or Single Flanged Beams.—Fig. 4.	w = the load in cwts.	b = AB the breadth in inches.	d = AG the depth in inches.
1	Fixed at one end and loaded at the other . . .	$lw = \frac{7{\cdot}6bd^2\,(1-qp^3)\,(1-q)}{(\sqrt{1-qp^3} + \sqrt{1-q})^2}$	$b = \frac{lw\,(\sqrt{1-qp^3} + \sqrt{1-q})^2}{7{\cdot}6\, d^2\,(1-qp^3)\,(1-q)}$	$d = \left(\frac{lw\,(\sqrt{1-qp^3} + \sqrt{1-b})^2}{7{\cdot}6\, b\,(1-qp^3)\,(1-q)}\right)^{\frac{1}{3}}$
2	Fixed at one end and loaded uniformly over the length .	$lw = \frac{15{\cdot}2\, bd^2\,(1-qp^3)\,(1-q)}{(\sqrt{1-qp^3} + \sqrt{1-q})^2}$	$b = \frac{pw\,(\sqrt{1-qp^3} + \sqrt{-}\ q)^2}{15{\cdot}2\, d^2\,(1-qp^3)\,(1-q)}$	$d = \left(\frac{lw\,(\sqrt{1-qp^3} + \sqrt{1-q})^2}{15{\cdot}2\, b\,(1-qp^3)\,(1-q)}\right)^{\frac{1}{3}}$
3	Supported at both ends and loaded at the middle . .	$lw = \frac{30{\cdot}4\, bd^2\,(1-qp^3)\,(1-q)}{(\sqrt{1-qp^2} + \sqrt{1-q})^2}$	$b = \frac{lw\,(\sqrt{1-qp^3} + \sqrt{1-q})^2}{30{\cdot}4\, d^2\,(1-qb^3)\,(1-q)}$	$d = \left(\frac{lw\,(\sqrt{1-qp^3} + \sqrt{1-q})^2}{30{\cdot}4\, b\,(1-qp^3)\,(1-q)}\right)^{\frac{1}{3}}$
4	Supported at both ends and loaded uniformly over the length .	$lw = \frac{60{\cdot}8\, bd^2\,(1-qp^3)\,(1-q)}{(\sqrt{1-qp^3} + \sqrt{1-q})^2}$	$b = \frac{lw\,(\sqrt{1-qp^3} + \sqrt{4-q})^2}{60{\cdot}8\, d^2\,(1-qp^3)\,(1-q)}$	$d - \left(\frac{lw(\sqrt{1-qp^3} + \sqrt{1-q})^2}{60{\cdot}8\, b\,(1-qp^3)\,(1-q)}\right)^{\frac{1}{3}}$
5	Fixed at both ends and loaded at the middle . . .	$lw = \frac{45{\cdot}6\, bd^2\,(1-qp^3)\,(1-q)}{(\sqrt{1-qp^3} + \sqrt{1-q})^2}$	$b = \frac{lw\,(\sqrt{1-qp^3} + \sqrt{4-q})^2}{45{\cdot}6\, d^2\,(1-qp^3)\,(1-q)}$	$d = \left(\frac{lw(\sqrt{1-qp^3} + \sqrt{1-q})^2}{45{\cdot}6\, b\,(1-qp^3)\,(1-q)}\right)^{\frac{1}{3}}$
6	Fixed at both ends and loaded uniformly over the length .	$lw = \frac{91{\cdot}2\, bd^2\,(1-qp^3)\,(1-q)}{(\sqrt{1-qp^3} + \sqrt{1-q})^2}$	$b = \frac{lw\,(\sqrt{1-qp^3} + \sqrt{4-q})^2}{91{\cdot}2\, d^2\,(1-qp^3)\,(1-q)}$	$d = \left(\frac{lw(\sqrt{1-qp^3} + \sqrt{1-q})^2}{91{\cdot}2\, b\,(1-qp^3)\,(1-q)}\right)^{\frac{1}{3}}$
7	Supported at both ends and loaded at some intermediate point	$mnw = \frac{7{\cdot}6bd^2\,(m+n)\,(1-qp^3)\,(1-q)}{(\sqrt{1-qp^3} + \sqrt{1-q})^2}$	$b = \frac{mnw\,(\sqrt{1-qp^3} + \sqrt{1-q})^2}{7{\cdot}6\, d^2(m+n)(1-qp^3)(1-q)}$	$d = \left(\frac{mnw\,(\sqrt{1-qp^3} + \sqrt{1-q})^2}{7{\cdot}6\, b\,(m+n)(1-qp^3)(1-q)}\right)^{\frac{1}{3}}$
8	Fixed at both ends and loaded at some intermediate point .	$mnw = \frac{11{\cdot}4\, bd^2\,(m+n)\,(1-qp^3)\,(1-q)}{(\sqrt{1-qp^3} + \sqrt{1-q})^2}$	$b = \frac{mnw\,(\sqrt{1-qp^3} + \sqrt{1-q})^2}{11{\cdot}4\, d^2(m+n)(1-qp^2)(1-b)}$	$d = \left(\frac{mnw(\sqrt{1-qp^3} + \sqrt{1-q})^2}{11{\cdot}4\, b\,(m+n)(1-qp^3)(1-q)}\right)^{\frac{1}{3}}$

b = A B the breadth, d = B D or A G the depth, $p = \frac{\text{D C}}{\text{B D}}$, and $q = \frac{\text{DE + FG}}{\text{AB}}$.

Fig. 4.

Transverse Section.



TABLES ON THE STRENGTH OF BEAMS.

	Square Beams.—Fig. 5.	w = the load in cwts.	s = AC the side in inches.
1	Fixed at one end and loaded at the other	$lw = 1{\cdot}9\,s^3$	$s=\left(\frac{lw}{1{\cdot}9}\right)^{\frac{1}{3}}$
2	Fixed at one end and loaded uniformly over the length	$lw = 3{\cdot}8\,s^3$	$s=\left(\frac{lw}{3{\cdot}8}\right)^{\frac{1}{3}}$
3	Supported at both ends and loaded at the middle	$lw = 7{\cdot}6\,s^3$	$s=\left(\frac{lw}{7{\cdot}6}\right)^{\frac{1}{3}}$
4	Supported at both ends and loaded uniformly over the length	$lw = 15{\cdot}2\,s^3$	$s=\left(\frac{lw}{15{\cdot}2}\right)^{\frac{1}{3}}$
5	Fixed at both ends and loaded at the middle	$lw = 11{\cdot}4\,s^3$	$s=\left(\frac{lw}{11{\cdot}4}\right)^{\frac{1}{3}}$
6	Fixed at both ends and loaded uniformly over the length	$lw = 22{\cdot}8\,s^3$	$s=\left(\frac{lw}{22{\cdot}8}\right)^{\frac{1}{3}}$
7	Supported at both ends and loaded at some intermediate point	$mnw = 1{\cdot}9\,(m+n)\,s^3$	$s=\left(\frac{mnw}{1{\cdot}9\,(m+n)}\right)^{\frac{1}{3}}$
8	Fixed at both ends and loaded at some intermediate point	$mnw = 2{\cdot}85\,(m+n)\,s^3$	$s=\left(\frac{mnw}{2{\cdot}85\,(m+n)}\right)^{\frac{1}{3}}$

s = A C the side of the section in inches.

Fig. 5.

Square section.

	Square Beams, the diagonal vertical.—Fig. 6.	w = the load in cwts.	s = AB the side in inches.
1	Fixed at one end and loaded at the other	$lw=1{\cdot}34\,s^3$	$s=\left(\frac{lw}{1{\cdot}34}\right)^{\frac{1}{3}}$
2	Fixed at one end and loaded uniformly over the length	$lw=2{\cdot}68\,s^3$	$s=\left(\frac{lw}{2{\cdot}68}\right)^{\frac{1}{3}}$
3	Supported at both ends and loaded at the middle	$lw=5{\cdot}36\,s^3$	$s=\left(\frac{lw}{5{\cdot}36}\right)^{\frac{1}{3}}$
4	Supported at both ends and loaded uniformly over the length	$lw=10{\cdot}72\,s^3$	$s=\left(\frac{lw}{10{\cdot}72}\right)^{\frac{1}{3}}$
5	Fixed at both ends and loaded at the middle	$lw=8{\cdot}04\,s^3$	$s=\left(\frac{lw}{8{\cdot}04}\right)^{\frac{1}{3}}$
5	Fixed at both ends and loaded uniformly over the length	$lw=16{\cdot}08\,s^3$	$s=\left(\frac{lw}{16{\cdot}08}\right)^{\frac{1}{3}}$
7	Supported at both ends and loaded at some intermediate point	$mnw=1{\cdot}34\,(m+n)\,s^3$	$s=\left(\frac{mnw}{1{\cdot}34\,(m+n)}\right)^{\frac{1}{3}}$
8	Fixed at both ends and loaded at some intermediate point	$mnw=2{\cdot}01\,(m+n)\,s^3$	$s=\left(\frac{mnw}{2{\cdot}01\,(m+n)}\right)^{\frac{1}{3}}$

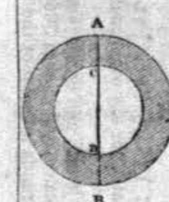
s = A B the side of the section in inches.

Fig. 6.

Square section, diagonal vertical.

Specific Cohesion, or Comparative Strength.	
Cast Iron, *Standard*	4·334
Arbutus	1·845
Ash, Red	1·899
White	1·804
Bay	1·547
Beech	1·880
Chestnut	1·291
Elm	1·432
Fir	1·380
American	0·942
Memel	1·154
Red	1·172
Riga	0·964
Russian	1·062
Scotch	0·837
Yellow	0·900
Larch, Scotch	0·837
Mahogany, Spanish	1·283
Maple	1·123

TABLES ON THE STRENGTH OF BEAMS.

	Cylindrical Beams.—Fig. 7.	w = the load in cwts.	d = AB the diameter in inches.	d = A B the diameter of the section in inches.	Specific Cohesion, or Comparative Strength.	
1	Fixed at one end and loaded at the other	$lw = 1{\cdot}112\, d^3$	$d = \left(\frac{lw}{1{\cdot}112}\right)^{\frac{1}{3}}$		Mulberry	1·492
2	Fixed at one end and loaded uniformly over the length	$lw = 2{\cdot}224\, d^3$	$d = \left(\frac{lw}{2{\cdot}224}\right)^{\frac{1}{3}}$	Fig. 7.	Oak, American	1·009
3	Supported at both ends and loaded at the middle	$lw = 4{\cdot}448\, d^3$	$d = \left(\frac{lw}{4{\cdot}448}\right)^{\frac{1}{3}}$	Circular Section.	British	1·509
4	Supported at both ends and loaded uniformly over the length	$lw = 8{\cdot}896\, d^3$	$d = \left(\frac{lw}{8{\cdot}896}\right)^{\frac{1}{3}}$		Baltic	1·211
5	Fixed at both ends and loaded at the middle	$lw = 6{\cdot}672\, d^3$	$d = \left(\frac{lw}{6{\cdot}672}\right)^{\frac{1}{3}}$		Dantzic	0·818
6	Fixed at both ends and loaded uniformly over the length	$lw = 13{\cdot}344\, d^3$	$d = \left(\frac{lw}{13{\cdot}344}\right)^{\frac{1}{3}}$		French	1·450
7	Supported at both ends and loaded at some intermediate point	$mnw = 1{\cdot}112\, (m+n)\, d^3$	$d = \left(\frac{mnw}{1{\cdot}112\, (m+n)}\right)^{\frac{1}{3}}$		Provence	1·455
					Orange	1·764
8	Fixed at both ends and loaded at some intermediate point	$mnw = 1{\cdot}668\, (m+n)\, d^3$	$d = \left(\frac{mnw}{1{\cdot}668\, (m+n)}\right)^{\frac{1}{3}}$		Pitch Pine	1·284
	Tubular Beams.—Fig. 8.	**w = the load in cwts.**	**d = AB the exterior diameter in inches.**	**d = A B the exterior diameter, and $p = \frac{CD}{AB}$**	Plum	1·357
1	Fixed at one end and loaded at the other	$lw = 1{\cdot}112\, d^3\, (1 - p^4)$	$d = \left(\frac{lw}{1{\cdot}112\, (1 - p^4)}\right)^{\frac{1}{3}}$		Pomegranate	1·221
					Poplar	0·705
2	Fixed at one end and loaded uniformly over the length	$lw = 2{\cdot}224\, d^3\, (1 - p^4)$	$d = \left(\frac{lw}{2{\cdot}224\, (1 - p^4)}\right)^{\frac{1}{3}}$	Fig. 8.	Quince	0·841
3	Supported at both ends and loaded at the middle	$lw = 4{\cdot}448\, d^3\, (1 - p^4)$	$d = \left(\frac{lw}{4{\cdot}448\, (1 - p^4)}\right)^{\frac{1}{3}}$	Transverse Section.	Tamarisk	1·194
4	Supported at both ends and loaded uniformly over the length	$lw = 8{\cdot}896\, d^3\, (1 - p^4)$	$d = \left(\frac{lw}{8{\cdot}896\, (1 - p^4)}\right)^{\frac{1}{3}}$		Teak, Java	1·509
5	Fixed at both ends and loaded at the middle	$lw = 6{\cdot}672\, d^3\, (1 - p^4)$	$d = \left(\frac{lw}{6{\cdot}672\, (1 - p^4)}\right)^{\frac{1}{3}}$		Malabar	1·395
6	Fixed at both ends and loaded uniformly over the length	$lw = 13{\cdot}344\, d^3\, (1 - p^4)$	$d = \left(\frac{lw}{13.344\, (1 - p^4)}\right)^{\frac{1}{3}}$			
7	Supported at both ends and loaded at some intermediate point	$mnw = 1{\cdot}112\, d^3\, (m+n)\, (1 - p^4)$	$d = \left(\frac{mnw}{1{\cdot}112\, (m+n)\, (1 - p^4)}\right)^{\frac{1}{3}}$			
8	Fixed at both ends and loaded at some intermediate point	$mnw = 1{\cdot}668\, d^3\, (m+n)\, (1 - p^4)$	$d = \left(\frac{mnw}{1{\cdot}668\, (m+n)\, (1 - p^4)}\right)^{\frac{1}{3}}$			

The following examples will suffice to show the application of the formulæ :—

Example 1. A cast iron beam of which the transverse section is a rectangle (fig. 1), is supported horizontally on two props placed at the distance of 36 feet apart ; what load will the beam sustain at its middle point including the effect produced by its own weight, its depth in the direction of gravity being 22 inches, horizontal breadth 3 inches, and specific gravity 7·372, that of water being unity ?

The formula by which this example is resolved, is number 3 of the compartment for the strength of rectangular beams, and by substituting the numerical values of b, d and l, we get

$$w=\frac{7·6\,b\,d^2}{l}=\frac{7·6\times3\times22^2}{36}=306·533 \text{ cwts.}$$

If the beam were of Memel Fir of which the specific cohesion is 1·154, that of the given material being 4·334 ; the strength would be found as follows :—

4·334 : 306·533 : : 1·154 : 81·62 cwt. nearly ; and in this way the strength may be calculated for any other material of which the specific cohesion is known.

Example 2. Let the length and depth remain as before, what must be the breadth to sustain the calculated load of 306·533 cwts ?

In this case the formula is No. 3 of the values of b, and by substitution, we get

$$b=\frac{lw}{7·6d^2}=\frac{36\times306·533}{7·6\times22^2}=3 \text{ inches.}$$

Example 3. Let the length and the breadth remain, what must be the depth to sustain the calculated load of 306·533 cwts ?

Here the formula is No. 3 in the values of d, and by substitution we obtain

$$d=\sqrt{\frac{lw}{7·6\,b}}=\sqrt{\frac{36\times306·533}{7·6\times3}}=22 \text{ inches.}$$

And exactly in the same manner may the strength, breadth and depth be calculated for any other case, observing always to employ the constant which is adapted to that particular case.

Example 4. A cast iron beam of which the transverse section is an open rectangle (fig. 2), is supported horizontally on two props 36 feet apart ; what load will the beam sustain when equally diffused throughout its length, the breadth being 3 inches, the whole depth 22 inches, the depth of the open part seven-tenths of the whole depth, and the specific gravity 7·372 ?

The formula for resolving this example is No. 4 of the compartment for open beams, where we have

$$w=\frac{15·2\,b\,d^2\,(1-p^3)}{l}=\frac{15·2\times3\times22^2\,(1-·7^3)}{36}=\frac{15·2\times3\times484\times·65\bar{7}}{36}=$$

402·7848.

The breadth and depth to bear the given load, may respectively be found as in the preceding case.

Example 5. A cast iron beam of the grooved or double flanged section (fig. 3), has its extremities fixed into solid walls which are 36 feet apart ; what must be its depth to support a load of 928 cwts. at the middle of its length, the whole breadth being 6 inches, the lesser or middle breadth three-eighths of the whole breadth, and the depth of the middle part or that between the flanges three-fourths of the whole depth ?

The formula for this example is No. 5 of the value of d, for the grooved or double flanged section, from which we have, $q=1-\frac{3}{8}=\frac{5}{8}=·625$, and $p=·75$, and therefore it is

$$d=\left(\frac{lw}{11·4\,b\,(1-qp)^3}\right)^{\frac{1}{2}}=\left(\frac{36\times928}{11·4\times6\,(1-·625\times·75)^3}\right)^{\frac{1}{2}}=25\tfrac{3}{4} \text{ in.}$$

and consequently, the depth between the flanges is $25·75\times·75=19·3125$ or $19\frac{5}{16}$ inches.

Example 6. The whole breadth of a feathered or single flanged beam is 8 inches, the lesser breadth 2 inches, the lesser depth $\frac{5}{8}$ of the whole depth, and the length 36 feet ; what must be the whole depth so that it may support a load of 1200 cwts. uniformly distributed over the length, supposing both its ends to be fixed as in the last example ?

The formula for this case is No. 6 of the values of d, for the single flanged or feathered section (fig. 4), from which we have $q=\frac{8-2}{8}=·75$ and $p=\frac{5}{8}=·625$; therefore by substitution we get

$$d=\left\{\frac{lw\;(\sqrt{\overline{1-qp^3}}+\sqrt{\overline{1-q}})^2}{91·26\,(\overline{1-qp^3}\times\overline{1-q})}\right\}^{\frac{1}{2}}=$$

$$\left\{\frac{36\times1200\,(\sqrt{\overline{1-·75\times·625^3}}+\sqrt{\overline{1-·75}})^2}{91·26\,(\overline{1-·75\times·625^3}\times\overline{1-·75})}\right\}^{\frac{1}{2}}=23·903 \text{ inches,}$$

nd consequently the lesser depth is $23·903\times·625=14·94$ inches.

From what has been done above, the mode of reducing the cases for the other sections will become manifest, and since our limits will not permit us to enter at large into the subject, the subsequent illustrations must be left for exercise to the reader.

RAILWAY BILL.

The Board of Trade has opened the campaign against the engineering interests, and we fear with better success than ever. Last year they were defeated on the Steam Navigation Bill, and obtained a partial success on the Railway Act, but by the mere passing of this measure, trivial as it was in itself, they have got the point of the wedge in, and are preparing to drive it home. Fortune has worked well for them in the interim, a series of lamentable accidents continued almost uninterruptedly during the recess, and the government borne on the full tide of public alarm and interested exaggeration, sail on to complete their victory. We attribute their success both last year and this, for we fear that it is already certain, to the inefficient manner in which the opposition was conducted, if indeed that could be called opposition which was to a great degree suicidal assistance. It is true the railway press thundered, but the great division among the railway interests prevented any effective combination, while officious individuals, anxious to show their importance by any kind of meddling, had full opportunity of deluding the ministers as to the feelings of the companies, and of being deluded themselves. We ourselves in this might have been in some degree to blame that we were satisfied with leaving the matter in the hands of the directors, and that we did not enforce that there were other interests also concerned, the representation of which could not fairly be trusted to a body having enough to do to defend themselves. It was a parallel case to the steam navigation bill, and had we done rightly we ought at once to have seen the course which it was our duty to have adopted. We felt that in the one case the steam-boat owners would neglect the interests of the marine engineers, and we aroused that branch of the profession to the necessity of uniting and protecting themselves, co-operating with the steam-boat owners in their opposition to the general principles of the bill, and keeping a watchful eye upon whatever was calculated to affect themselves in particular. A similar course of proceeding it now becomes incumbent upon us to urge in the present instance, the railway directors are absolutely insensible to the dangers which menace themselves, so that it is worse than useless to expect that they will afford any protection to those much more menaced—the engineers. We have seen the disposition to interfere with the due exercise of the profession manifested in the steam navigation bill, and we see it still further developed in the report of the railway commissioners to the Board of Trade. In this report the engineers may find what is in store for them.

With regard to the nature and extent of these powers, the proper distinction appears to us to be that the Government should not attempt to interfere in questions of an experimental nature, which are still subjects of discussion, and admit of a fair difference of opinion among practical men ; nor should it attempt to regulate matters of detail, so as to take the management of the railways out of the hands of the parties immediately responsible, viz., the Directors and their officers.

On the other hand, the Government should have the power of enforcing, whenever it is found necessary, the observance of all precautions and regulations which are approved by experince, and are obviously conducive to the public safety. For instance, upon such points as the comparative advantages of six and four-wheeled engines, the best construction and mode of laying down rails, the best form and construction of wheels, axles, &c., and other points of a similar nature, upon which the practice of the best conducted railways differs, and the opinion of the most eminent engineers is by no means decided, it would be premature for the Government to interfere until experience has solved the questions which may still be fairly considered as doubtful.

Here we have an admission that although government do not now interfere, they reserve the right of "doing so at a future period, and they claim the power of introducing upon all railways, whatever has been adopted and proved to be conducive to safety by the practice of those which are considered to be the best conducted." Proved! what has been proved in these days of invention and innovation, has the stage coach been proved? has the sailing vessel? has timber been proved to be the best material for ships? What has been proved to be perfect, or impossible to be superseded? and the Board of Trade would come forward and deprive the engineer of the freedom of competition. Would commissioners, advocates of the fifty-six inch gauge, have allowed the broad gauge and all the consequences attendant on it, or would they have been satisfied with what had been adopted and approved upon the best conducted railways? Would turnpike road

commissioners have allowed an approved and adopted mode of communication to be superseded? Let us recollect that invention is already at work to supersede the locomotive, that many of these plans, although not yet brought to bear, have shown great ingenuity, and have been made to work; and is competition to be dependent on the dictum of government commissioners? If the engineers think they will work best in government harness, let them be submissive; if they do not think so, let them at once step forward, and act before it is too late. The railway engineer has had his province invaded often enough by Irish and English railway commissioners to know what he has to expect, so that he ought to want but little urging to impel him to do his duty. The locomotive engineer will see that he has advisers ready to dictate to him the number and form of the wheels of his engines, the axles "and other points of a similar nature," whose thraldom, unless he escape by his own exertions, he will find it difficult to avoid. The marine engineers, and the other branches of the profession have their interests concerned in those of the profession generally, and they must recollect that in fighting this battle they are fighting their own. "Lazarus is not dead, he only sleepeth,"—steam navigation jobs, if they have one head cut off, hydra-like always produce more, and the success of the railway measure will furnish a precedent by which other and more stringent enactments may be obtained. We call therefore on the profession generally to meet, and resist the proposed invasion of their rights—to dismiss all personal disputes on this occasion, and to see only their personal interests—let the younger members of the profession not be behind hand, their career is before them, and if they do not wish their prospects to be blighted, and themselves converted into a set of government sycophants, let them support their elder brethren in maintaining the general cause. We have "nostro consilio" successfully aided in one campaign, we have been rewarded by the thanks of the interest, which we defended, and we pledge also on the issue of the present effort, the same exertions and the same regard for the rights of our constituency.

The chief stipulations which we consider that the profession should make with the government are,

First. That as little interference as possible should take place upon subjects connected with engineering, and that such interference should be limited to matters rendered absolutely imperative by public safety.

Second. That no regulation should be made without the subject in question having been duly investigated, either by the Institute of Civil Engineers, or by a commission composed of engineers belonging to the branch to which the subject relates, not railway commissioners, government engineers, or royal engineers.

Third. That examinations directed by the act shall be public, according to a regulated and uniform plan, and shall be conducted by the Institute of Civil Engineers, or by the departments of Engineering of the Universities of London, Glasgow or Durham.

Fourth. That in case of a difference of opinion between the commissioners and engineers, it shall be left to the decision of arbitrators nominated by each party.

Fifth. That a portion of the railway commission shall be composed of civil engineers.

ENGINE DRIVERS ON RAILWAYS.

THE late accidents on railways, and the unfortunate loss of life which has occurred in many cases, have naturally directed public attention more forcibly towards providing some efficient remedy against their recurrence; for although it is very true that the accidents frequent by the former method of conveying the public by coaches were, for the most part, attended by a much greater proportionate loss of life than has occurred on railways, we naturally expect that the talent and expenditure employed in completing these undertakings would have obviated such calamities by foresight and arrangement, and in confirmation of the justice of this opinion, it is further remarkable that accidents, till recently, have been very unfrequent and seldom attended by loss of life. Many railways were opened during the past year, and their want of organization may have tended to cause irregularity. We may also be allowed to entertain an opinion that previous success on older railways has caused, in some degree, a relaxation of care on the part of those entrusted with the management of new ones, both in the selection of proper officers, and in carrying out the recommendations of those professionally engaged in the practical detail, so as to effect that uniformity of action throughout the entire establishment which is necessary to insure success. In the management of a railway, as in that of the army, it appears necessary that business should be conducted by a head manager, deriving his authority and receiving instructions immediately from the board of directors, having under him gradations of officers, who should be held responsible for the due performance of the duties of themselves and their subordinates, and have the power of appeal to the board of directors in cases of dispute, they should also be protected from the individual interference of receiving orders from any other than their superior officer in each department respectively, and these superior officers from the manager as the official organ of the directors.

It may be argued by many, that such an arrangement as we propose would open a door to abuse of power by the superior officers and manager, but a determination on the part of the directors to maintain order and gentlemanly feeling among them, by considering with impartiality and minuteness every case of appeal brought under their notice, and by reprimanding the delinquent, however high his station, would effectually curb any such evil.

Most, if not all, railway companies have established some code of regulations for a portion, at least, of their servants but recent inquiries seem to show that they have not always been enforced with the decision necessary to render them available in all cases, and it is doubtful how far they may embrace and define the duties of every servant connected with the executive, for unless their respective responsibilities are clearly understood, it will become difficult to ascertain which of two parties may have acted improperly, although each be actuated by a laudable desire to further the safety of the public and the prosperity of the railway; the decision on the part of the directors becomes doubtful, and perhaps the occasion may pass without being legislated upon at all, or at most an order is passed which, being observed for a time, falls into disuse from its isolated character; and if it becomes necessary to adopt any improved local arrangement, this is also in danger of being applied to individual cases rather than to the general system.

The responsible duties of the engine-driver conducting each railway train, have marked him out as the peculiar object of public inquiry and censure, and it may be naturally assumed as unfortunate that these men have risen in many cases from classes uneducated, so far as book learning is concerned. The knowledge of reading and writing, no doubt, gives man a moral standing and feeling of confidence that can be acquired in no other way, but we by no means admit that engine drivers are uneducated for the duties required of them, after having undergone a practical apprenticeship for many years as assistants on the engines they emulate to conduct, and being intrusted with their care after proving themselves sober and attentive servants.

Men educated in the theoretical knowledge of the laws of latent heat and expansion of fluids, would, we think, be quite unable to conduct an engine ten miles without an accident, unless they were practically initiated in its management by serving an apprenticeship to the more menial duties; and it is very doubtful how far he would exercise the continued watchfulness and caution necessary, if the sense of danger were removed by too much confidence in the efficiency of an education such as has been proposed by sending them to institutions for acquiring this knowledge.

Of the many accidents which have lately occurred on railways, we think that there has been a prevalent want of system in giving signals, as well as disregard of duty in not exhibiting them. To render signals efficient, they should be conducted with the *greatest simplicity* as well as certainty, and where many signs are sought to be conveyed, as proposed by the Railway Conference, there is great danger of an improper one being used. Where a signal of danger becomes necessary, it must generally occur from irregularity or accident, and we think the railway system will not be complete until provided with a ready means of immediately transmitting information to every part of the line, as by telegraph. This has been adopted on a short line in the metropolis on the electro-magnetic principle with eminent success; indeed we doubt if the business could be conducted with safety unless provided with such an instrument; an efficient means of communication is also required between the guards and engineer of the train, to give information of any accident that may occur to a carriage or otherwise.

Engine drivers are, however, placed in so important a relation to the safety and proper conduct of railway trains, that it has become a serious necessity, felt alike by the proprietors of railways and the public, that they should become or be chosen from a superior class of operatives, and it is their position to which we wish to call more immediate attention. To attain this object it is indispensably requisite that their moral conduct and emulation in the skilful discharge of their duties should be fostered by the due consideration of their superior officers and employers, and that they should be carefully protected from interference or injustice when acting with propriety. As a reward for merit we should recommend an honorary, rather than a pecuniary consideration. A medal, we think, would prove a more certain inducement, from its being, *sui generis*, a certificate of good character.

By law, engine drivers of railway trains have not hitherto been contemplated as a distinct body, nor have their duties and responsibilities been defined, except in general acts relating to all servants of railway companies, and it is to this point we think the attention of legislature may be directed with peculiar advantage; in case of accident occurring from negligence, it is of vital importance to the community at large that at any rate the delinquent should not again be suffered to risk the loss of life, the mere punishment by fine or otherwise is not enough to protect the public, and no combination of the railway interest to denounce the man as unfit for the trust is sufficient to meet the case, for unless the delinquent has been condemned by an impartial judge, fully competent to understand the case, it remains uncertain if he or some other have been guilty of the offence, and opens a door to persecution which will effectually prevent men of honourable intentions from accepting duties of so arduous a nature; it is therefore as necessary that they should be protected from injury when discharging their duties with fidelity and care, as that they should be punished when the reverse obtains, and to attain this object we should propose that men in this occupation be governed by laws in some measure similar to those enacted for the observance of pilots, to whose duties as conductors and guardians of life and property they approximate more nearly than to any other.

For this purpose it will be necessary to institute a corporation similar to that of the Trinity House, whose duty and responsibility it should be to examine and grant licences to proper persons for the conduct of railway engines, and to make bye laws for their regulation, and enforce them after approval of the Privy Council, which bye laws should be publicly exhibited for the inspection of all persons interested therein, for at least three months previous to being enforced. In carrying out the intentions of a new act of this description, it would be necessary to allow some latitude in the granting of licences to those who are at present engaged as engine drivers. In future, however, those entrusted with the charge of engines might be divided into three classes, viz., 1st, engine drivers; 2nd, engine drivers or stokers; and 3rd, apprentices; the two former should always accompany the engine, and perhaps the apprentice also, whose instruction should, however, in part consist of mechanical knowledge acquired in the workshops; as fitter each man should derive his authority to act in either capacity by licence, stating the grade to which he belonged, granted after due examination and certificate on oath of the examining officer, which licence should be renewed every year. Each apprentice should serve five years before he becomes eligible to receive a licence as second engine driver, and each second engine driver should further serve three years before he is entrusted with the entire command of an engine as first engine-man, when he should execute a bond for securing obedience to the bye-laws. An annual premium should be paid for each licence, to defray the expenses of carrying out the act, and the surplus be carried to a fund for superannuated and infirm drivers, which fund should be also provided for by a per centage of (say) sixpence per pound retained from their earnings when employed. All appointments should be registered. Licences should be revoked, annulled, or suspended by the engineer-in-chief, and those suspended may appeal to the corporation.

No unlicensed person should take charge of any engine, under a penalty. The description should appear on his licence, and none be allowed to act until registered, or without producing his licence. He should deliver up his licence when required, and be liable to penalty for acting when suspended. He should be liable for lending his licence, for drunkenness or misconduct. Drivers quitting without consent should be liable to penalty, and a penalty should be enforced on railway companies for employing unlicenced engine drivers. Penalties should be appropriated to a relief fund. It would not, however, be a sufficient security to the public that the engine drivers only be made subject to these or similar regulations, it is imperative that all other servants connected with the transmission of trains should be subjected to similar regulations and strict definition of respective duties.

We think it has been far too frequently the practice to allow blame to be cast on the engine drivers, rather than sift to the bottom who may have been the real delinquent, and it has been lost sight of by the public, that perhaps eight out of ten of the late disastrous accidents are not wholly attributable to their negligence, and that such a groundless charge against a body of men when endeavouring to exert their utmost abilities, is calculated to cause a bad moral influence, and debar intelligent persons from accepting a situation where no protection is afforded.

DRAINAGE BILL.

We have long wished that some measure should be brought forward to provide an efficient system of architectural police, and we are pleased to see at last some hopes of this being effected. In the hands of the architect and the engineer to a great degree are left the health and happiness of the population, and this is particularly the case in large towns. The medical man does but follow, for the responsibility lies more on the architect than on any one else. Most of the requisites for health depend on the due administration of his duties, food is supplied by others, but he has to provide lodging, water, drainage—nay, it may be said, even air. If we want to appreciate how great is this responsibility, let us take two cases from this metropolis, we will take the western or Kensington division, and the eastern or Whitechapel division, in the former the annual average of deaths is 2·2 per cent., in in the latter 3·4 or more than 50 per cent. higher, a result attributable mainly to the want of drainage and to the bad mode of construction. In Whitechapel there are as many as four females in a hundred who die in a year, an average as low as that of Lisbon, while as we have seen, in another part of the metropolis the average is little more than one half. It is not our purpose at present to enter at any length into this subject, for we presume that our readers must be too well aware by experience of the main facts—we here however state it as our decided conviction that one-third of the deaths in this metropolis, causing an annual loss of Ten Thousand Lives, is mainly owing to the inefficiency of our architectural police, and let it be remembered that London is one of the healthiest cities in the world, that even the great partial mortality of which we have spoken is nothing to that of Dublin, Manchester, Glasgow or Birmingham—still in the last ten years One Hundred Thousand Lives have been sacrificed in this metropolis of civilization through the ignorance of the public, and the negligence of the legislature.

Upon the architect, we have explained, that there devolves a high share of responsibility, that upon the due discharge of his duties the health of his fellow-citizens is dependent, we therefore say that it is incumbent on the profession not to be supine under such circumstances, but to give every aid in their power towards remedying the evils which have sprung from a bad system. The proper fulfilment of these onerous duties gives the architect a high claim upon the public sympathy, and must tend to raise the moral and social position of the profession. The architect ceases to be an artist, whom we call in to minister to our luxuries, or a mechanic, whose brick and mortar services we can cheaply pay, he comes before us in another capacity, he has more weighty cares, and the public will not only give him a larger share of their esteem, but a greater measure of power. It is to instructed men that the public have to look for the efficient direction of a proper system, and to no other hands can it be satisfactorily confided. We therefore call on the profession in the consideration of this important question to dismiss their private interests, and to consult only their public obligations, to look with kindness at measures calculated to elevate the dignity of their pursuits, and to see defects only for the purpose of giving every assistance to amend them.

We confess that the consideration of recommendations, such as those contained in the Drainage Bill, is to a certain extent involved in difficulty, for an interference with existing modes is evidently calculated to disturb and seriously injure many private interests. By the proposed enactment the landed proprietor will not be allowed to build as he likes, he will be put to expenses which he would be anxious to avoid, and he will not be able to make as much as he formerly could of his property. This is the first feeling suggested on reading the bill, but we should take but a narrow view of the question did we limit ourselves to such a view. There are other private interests concerned besides those of the holder of building ground, there are the interests of all classes of the community which are affected by the bad working of the present system. Let us suppose that in the midst of Pimlico or the Regent's Park, among houses in which every comfort has been studied, a small plot should be left unbuilt, it is clearly in the power of the owner at present from the demand for habitations created by the population already established in the neighbourhood—it is clearly in the power of the owner, we say, to establish a pernicious fever colony in the midst of the most healthy district. In his anxiety to make the most of his property he may, as others have done, build a nest of houses, back to back, with narrow alleys, no thoroughfare, and without drainage, and without provision for the removal of filth of any kind, or he may do worse by letting all the refuse fill one open drain. Let the windows be small and immoveable, the rooms of the most cramped dimension, let him fill these houses with those who are unfortunately competitors for the worst accommodation, and malaria will do the rest—fever will spring up in the devoted district, the houses of the poor

will be desolated, death will do his work in every house, ten, twenty, thirty cases of disease in one habitation—the leaven has worked, and pestilence will go abroad to carry its warfare among the rich and the beautiful, and teach its awful lesson of the common interests and common liabilities of human nature. This is no exaggerated picture, no effort of the imagination, we can point out the districts, name the houses, number the victims,—a fever map of the metropolis would be dotted with black and livid colonies of death—here is the active volcanoe, here is that which has had its day of ravage and now slumbers for awhile—in that darkened alley, where there is scarcely a pathway for the solitary visitor, sixty cases of fever have broken out at once—that row of lodging houses forms one perpetual hospital, the surgeon is never absent from its doors, the hearse is a punctual visitor. All the evils, which we have depicted, may be brought about by ignorance or negligence, and there is no remedy, except at the expense of the victims. The sewers are made from the general rates, the union officer is sent to cure the sick, the weakened labourer, the widow and the orphan become burthens on the poor rates, the public slumber, another crop is prepared for the scythe, the same scene is repeated, and still we remain inactive. It would be no exaggeration to say that the portion of poor rates in Marylebone immediately attributable to fever colonies is not less than twenty per cent., a heavy penalty for private cupidity and public negligence. It is therefore no valid interest for which the landowner would ask protection, he has profited by a public wrong, and on the remedy of that evil he must abide the consequences, were they more severe than they are likely to be, while he will equally profit by the public advantage. The results to be expected from an efficient system of architectural hygiene are a diminished rate of mortality among all classes, and a considerable reduction in the poor rates—advantages, we presume, in the contemplation of which all private interests must sink in the scale. The amount of poor rates for the metropolis alone is above half a million, a sum the diminution of which cannot fail to be a boon, while it will furnish a good set-off against any expenditure which may be necessary under the new arrangements. In the profession, as regards personal interests, the same compensation will be the result, if any loss should be sustained by the builders of low class houses, yet there is again in the increased activity given to other departments.

Taking up the bill itself, under these circumstances, and considering that it has yet to pass through committee, we shall bear but slightly upon its individual details, for although many of them are highly objectionable, yet as a general feeling prevails that they will be amended in the further progress of the measure, it would be but wasting the time of our readers. The first clause by including every borough and market town, necessarily takes in many places of small population, in which the proposed enactment would be unnecessary, we should therefore suggest, that there should be a general limitation, to the wording of the clause any borough, market town, town or village, having more than —— thousand inhabitants. We certainly think that it is but equitable that those proposing to build on any property should provide it with proper sewers; streets are as much for the public as for private use, but sewers are more for private use than for that of the public. The second clause, which is retrospective, and requires drains to be made for unprovided houses now existing, we think bears particularly hard upon the occupier, and we hope will receive due modification. The third clause provides for the alteration of foundations on rebuilding old houses, and though it will prove burthensome, is a necessary consequence of the general tenour of the bill. The seventh clause gives a usual and necessary power to commissioners of sewers to open any private drain, and the eighth, power of compulsory cleansing of drains, water-courses and cesspools. The seventeenth clause provides for the inspection of all proposed buildings by the surveyor, who is to see that the provisions of the act are complied with, fixing a maximum fee of 3*l.* 10*s.*, and a minimum of 15*s.* The nineteenth section enacts that houses are not to be built below the level of the ground without areas. The 20th clause declares that no close court shall be built nor any of less width than 20 feet; the Marquis of Northampton who has already alluded to the subject, will probably move as an amendment that the width of alleys and streets be regulated by the height of the houses. By the succeeding clause houses may not be built back to back. The 23rd section says that walls shall be founded on concrete; the 24th that the level of the ground floor shall be at least 18 inches above the level of the footway or road adjoining, and air bricks shall be built in the walls 9 inches below the level of the floor, so as to allow of the free circulation of air beneath. The 25th section is the one, which has excited the most attention; it provides that no room in any house having only one room on the ground floor, or having only four rooms in all shall be less than eight feet in height, and that in every such house there shall be at least one room 12 feet by 12 in the clear. The next section provides that every room containing 144 square feet of flooring shall have at least one window of specified size, which admits of being opened freely. The restriction as to height and breadth appears to be bad, as the object might be answered effectually by requiring a superficies for windows of 14 square feet and a quarter. The 27th clause declares that cellars shall not be occupied as dwellings, but it seems very difficult at present to carry such a provision into effect, for in Liverpool there are 35,000 persons living in cellars, and in Manchester 15,000, a population which it would be inconvenient suddenly to dislodge.

By next month the bill will have assumed a more tangible form, and we shall then be enabled to consider in what way the clauses will bear on the profession, but at present, with the prospect of extensive modifications, we feel that this labour would be useless.

THE HALICARNASSIAN MARBLES.

The attention of the learned world has lately been much attracted to the precious remains of ancient art still existing in Asia Minor. The researches of the Dilettanti Society had contributed not a little towards a knowledge of some of its architectural monuments; and the labours of Captain Beaufort had opened the means of acquaintance with the southern coast. But it was not until the publication of the travels of Mr. Fellows, in 1839, that the public became aware of the extent of the treasures that exist in that most important part of the ancient world. In consequence of the interest excited by his work, Mr. Fellows was induced to return to that country, under the auspices of the Geographical Society; and we are informed that the result of his journey has been the acquisition for the British Museum of some sculptures of a most valuable character, from Lycia; and the construction of a correct map of a portion of classic ground which Lieutenant-Colonel Leake describes as "a complete blank." So little was known of the interior of Asia Minor, that it was left for Mr. Fellows to make the discovery of various cities of great extent, with whose very names no previous acquaintance had existed, among which one may be particularized numbering a population of not fewer than 30,000 souls. We trust that the result of these researches will soon be brought before the public. In the mean while it is our present purpose to solicit attention to the fact of the existence of some highly valuable remains of antiquity at Halicarnassus, the ancient and celebrated capital of Carya, in order that advantage may be taken of our present favourable position with regard to Turkey, and that, while our fleet is in the immediate neighbourhood, the sculptures in question may be rescued from the ignorance and barbarism of their present possessors.

Halicarnassus was situate on the coast of Asia Minor, near its southwestern extremity; and, upon the death of Mausolus, the King of Carya, B.C. 330, it became remarkable as the site of that famous monument erected to his memory by his Queen Artemisia, which gave the name of Mausoleum to all similar structures, and which is so elaborately described by Pliny. The present name of this place is Boudroun, and it forms a part of the province of Anatolia or Anaboudl. Boudroun appears to be, through the term Petrumi, as the Turks write it, a corruption of Pietro, or "Castellum Sancti Petri." The best account of this spot and its antiquities, with which we have been able to meet, is that contained in *Dr. Clarke's Travels*, vol. iii., pp. 256 and 268. In a note on the latter page, he says, "We are indebted for the information which follows, concerning Halicarnassus and Cnidus, together with the plan which accompanies it, to the observations of Mr. Morritt, celebrated for his controversy with Mr. Bryant on the subject of Homer's Poems and the existence of Troy. It is the more valuable, because few modern writers have visited these ruins; and certainly no one better qualified for the undertaking :—

"June 14, 1795.—We set out in a boat from Cos, and in a few hours reached Boudroun, the ancient Halicarnassus, a distance of 18 computed Turkish miles. This small town stands on a shallow bay, at the eastern extremity of the large and deep port of the ancient city. Off this bay lies the island mentioned in Strabo by the name of Arconnesos, Αρκοννησος. (Lib. xiv., p. 656.)

"June 15.—We tried to procure permission from the disdar, the Turkish governor of the castle, to see the interior of that fortress; but after a long negotiation we were at last only permitted to walk with a janissary round the open ramparts, his jealousy not permitting the inner gates to be opened into the court. The castle is a work of modern date, but built in a great degree of ancient materials, confusedly put together in the walls. There is a plate which gives a correct notion of its general appearance in the *Voyage Pittoresque*. We found over the door an ill-carved lion, and a mutilated bust of ancient work. Old coats of arms, the remains probably of the Crusaders and the

knights of St. John of Rhodes, are mixed in the walls with many precious fragments of the finest periods of Grecian art. There are several pieces of an ancient frieze, representing the combats of Theseus and the Amazons, of which the design and execution are equal to those which Lord Elgin brought over from the Parthenon. These are stuck in the wall, some of them reversed, some edgewise, and some which have probably been better preserved by having the carved side towards the wall, and inserted in it. No entreaties nor bribes could procure these at the time we were abroad; but now, if they could be procured, they would form, I think, a most valuable supplement to the monuments already brought hither from Athens. From my recollection of them, I should say they were of a higher finish, rather better preserved, and the design of a date somewhat subsequent to those of Phidias, the proportions less massive, and the forms of a softer, more flowing, and less severe character. It is probable that these beautiful marbles were taken from the celebrated Mausoleum; of this, however, no other remains are discoverable in those parts of the town we were permitted to examine. I found an inscription this day, near a fountain in the town, containing hexameter and pentameter lines, on the consecration or dedication of some person to Apollo."

In allusion to the same subject, Captain Beaufort has remarked, "Numerous pieces of exquisite sculpture are inserted in the walls, representing funeral processions, and combats between clothed and naked figures."

The Bay of Marmorice, where our squadron is now wintering, is in the immediate neighbourhood of Boudroun; and the facilities arising from this circumstance have produced much anxiety that the attention of the Government should be called to the facts thus briefly adverted to. In compliance with a memorial on the subject from the Architectural Society, Lord Palmerston recently granted the honour of an interview to a deputation from that body, at which the president, Mr. W. Tite, and the secretary, Mr. Grellier, laid before his Lordship a statement of all the authorities they had collected upon the existence and present condition of the remains under consideration. His Lordship promised that he would write to Lord Ponsonby and Admiral Stopford on the subject; and we have only to express our hope that his negotiation may terminate in the acquisition of these sculptures for our national museum, where they will form a noble link in the chain of Grecian art, and compensate in some measure for the loss of the Phigalean and other marbles.—*Times.*

[In addition to the foregoing extract from the *Times*, it will be seen by the correspondence which we have subjoined, that the Institute has not been behindhand in taking up this subject. We are gratified with the prospects which arise from Lord Palmerston's active and kind interference.]

COPY OF A LETTER FROM THE ROYAL INSTITUTE OF BRITISH ARCHITECTS TO LORD PALMERSTON.

MY LORD—The Institute of British Architects, having become acquainted, through some of its members who have visited Boudroun, the ancient Halicarnassus, that there are several fine specimens of Grecian sculpture inserted in the walls of the Castle without any regard to the danger they incur in such a situation, are induced to submit to your Lordship that it is most desirable to take advantage of the present favourable epoch for obtaining, if possible, the accession of these valuable relics of antiquity to our national collection, for their rescue from the degradation and destruction to which they are now exposed, and for the advancement of British art. In addition to the feeling which the members of the Institute entertain in common with others connected with the fine arts on the subject of these marbles, they attach the greater interest to their acquisition from the circumstance that they originally formed the decorations of a celebrated structure of ancient Greece.

The Council of the Institute further presume most respectfully to suggest to your lordship, that in the event of Her Majesty's government applying to the Sublime Porte for these sculptures, it would be desirable, at the same time, to request an authority to search for, and remove other remains of ancient art on that site and others on the coast of the Levant, where numerous valuable relics are well known to exist; and should this suggestion be entertained, the Institute, through its members who have visited the localities in question, will have much pleasure in contributing every information and assistance in their power to promote an object so important.

We have the honour to be,
Your Lordship's most obedient and humble servants,

C. FOWLER, } *Hon. Secs.*
A. POYNTER, }

The Lord Palmerston.

(REPLY.)

Foreign Office, Feb. 9, 1841.

GENTLEMEN—I am directed by Viscount Palmerston to acquaint you for the information of the Members of the "Royal Institute of British Architects" that in compliance with the request contained in your letter of the 29th ultimo, his Lordship has instructed her Majesty's Ambassador at Constantinople to endeavour to obtain the permission of the Porte, for the removal of the ancient sculptures at Boudroun, mentioned in your letter, and also for the removal of the other marbles in the neighbouring districts alluded to in your letter.

I am, Gentlemen,
Your most obedient humble servant,
J. BACKHOUSE.

C. Fowler, Esq., and A. Poynter, Esq.

THE COMMERCIAL DOCKS AT SOUTHAMPTON.

This central port, considered in its adjacency to the ocean, is at the same time, the most convenient for commerce. It has the Isle of Wight for a breakwater, with entrances on the west, by the Needles—on the south, by Spithead and the Mother Bank, with the Waters of the Solent for a sheltured outer anchorage. The harbour itself is most admirably fitted for the accommodation of trade, being ten miles in length, four miles above, and six miles below Southampton, with a wide and abundantly deep channel and the best anchorage. Nature has likewise provided a situation peculiarly fitted for commercial docks, at the very foot of the town of Southampton, and immediately contiguous to the South Western Railway, the connecting link between this noble harbour and the river Thames: the site of the docks, 208 acres in extent, is accessible on three sides, by the river Itchen and Southampton water—the most protected side being the margin of the Itchen—where the water is 12 feet, low water spring tides, and which is being dredged to the depth of 18 feet.

One of the docks now in progress, is intended to be opened at the expiration of six months or thereabouts, which will contain 16 acres of water, of the depth of 18 feet, low water spring tides, open at all times of tide, with an entrance of 150 feet in width, avoiding the expense of constructing and working entrance locks, and preventing any occasion of delay in entering or departing. To these important considerations, never before combined in any similar enterprize, is to be added, that the wharf ground, between the northern frontage of the two docks to be first constructed and the town, is of a description so ample as to admit of goods being lodged or housed in large quantities, under sheds and in warehouses, having vaults and a ground floor only, or of being otherwise so constructed as to require but little cranage.

The inducements to resort to these docks may be thus explained—first, as to the merchant of Liverpool,—second, as to the merchant of London.

1. As to the merchant of Liverpool.

It is well known that a given value in exports from Lancashire is comprehended in much less bulk than the same value invested in the produce of the countries to which the outward cargoes are exported, and that the colonial or other produce imported in return, is of much greater amount than is required for the market of Liverpool. The surplus is, in part, now consigned to London, but it must be obvious that provided as good a market can be found at Southampton, the merchant of Liverpool will prefer that port to London, for the following reasons.

1. The more early arrival of the vessel at its destination.
2. The smaller expenses of the port, in pilotage, light duties and other charges.
3. The nearer proximity of Liverpool, should the vessel be required to load outwards at that port; or if not, the shorter voyage to its ultimate destination, if down channel.

These reasons may be considered as conclusive, provided there be an equally good market for the inward cargo.

With reference to that question, it may be stated, that two millions and upwards of people are now supplied with grocery, fruits both green and dry, and other imports, first carried past the Port of Southampton, to encounter the delays, and be incumbered with the expenses of the navigation to and at the Port of London—which delay and expenses are doubled in conveying back these goods to the ports of the English channel, between Newhaven and Falmouth. Thus are two millions and upwards of the inhabitants of England now supplied with articles of import, instead of this merchandize being landed at Southampton, to be distributed with the greatest facility, weather permitting, to the Isle of Wight, and the numerous ports on the channel, New-

haven, Chichester, Portsmouth, Lymington, Poole, Weymouth, Bridport, Lyme, Dartmouth, Exeter, Teignmouth, Plymouth and Falmouth. That the merchant of Liverpool will be most anxious to profit by this opportunity of sharing, more largely, at an easy expense, in the supply of the markets of the south-west of England, cannot be doubted, and that he will therefore freely use the port of Southampton, may be considered as certain.

2. As to the merchant of London.

He has also to consider how to deliver goods to the consumer with the greatest despatch and encumbered with the least expense. Even supposing him to determine not to deviate from the old and beaten tracks of business, the effect must be, the abandonment of the markets of the South West, to the activity and enterprize of the merchant in the North West of England. Such a case, however, will not arise, nor will the merchants of London be slow, although some may be unwilling, to avail themselves of the means of despatch, economy and other advantages attendant on the adoption of Southampton as a branch port.

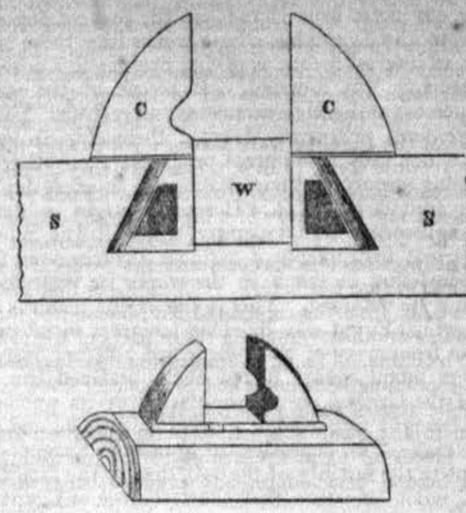
Nor are the inducements to prefer the Port of Southampton confined to the home trade. The large quantities of merchandize now brought to the Port of London to be re-shipped for colonial and foreign markets, will find a cheaper and more convenient depôt at Southampton, and especially the extensive class of imports from Java, the Brazils, Havannah and other foreign states or possessions, destined for foreign consumption, will, as matter of course, be carried to that port which can be the soonest reached, is the least expensive and the best situate for general distribution to the consumer, and such will be the Port of Southampton, being, at the same time, not less adapted for the collection of the outward cargo, now brought into the Port of London to be carried out again at a heavy expense.

The dock intended to be opened in September next, is to contain, as already mentioned, 16 acres. The second dock, also in progress, which is to be a close dock, will contain 14 acres of water—the whole of the enclosure of land and water, for these two docks, will comprehend about 60 acres, affording an extent of accommodation capable of yielding, if fully employed, at the rates charged by the docks of London, a nett income of £150,000 per annum, upon an outlay of £500,000 or thereabouts, of which it is proposed, agreeably to the provisions of the Act incorporating the Company, to borrow £150,000. There would then remain to be enclosed 140 acres more of the dock land. It would be premature to indicate by more than a slight sketch the probable occupation of that part of the site. It may, however, be shown, that there are easy, cheap and profitable means of using this ground so soon as sufficient trade shall have been attracted to Southampton to justify an extension of the works already undertaken. About 90 acres of the 140, running south of the present works would furnish ample accommodation for a trade in timber and coals—by being divided into two parts—a dock for timber ships and colliers, and an enclosure for timber ponds, where timber both afloat and in stack, might be bonded to a great extent. The then remaining part of the dock land would be about 50 acres, on the western side, bounded by Southampton water, a situation admirably calculated for a second close dock, should it ever be required. The works of the first or tide dock are far advanced,—it is intended to be opened to the merchant and shipowner in the month of September next; the second or close dock will require another year.

The Royal Mail Steam Packet Company is under engagement to work to and from this dock. The extensive trade now conveyed by the Peninsular Steam Packets has already located itself at Southampton, several ships run to the Mauritius from this Port for sugar, and it is well known that large commercial capitals both of London and Liverpool employed in the East and West India trades are awaiting the accommodation of these docks, in order to avail themselves at the earliest moment, of the advantages of supplying the large and flourishing population of the South West of England on terms with which it will be impossible to compete, by subjecting merchandize (in bringing it to London) to an average delay not to be estimated at less than one month (including the two passages), and at the same time to the heavy and oppressive expenses of the Port of London, and of its export from that Port, for distribution for domestic and foreign consumption.

Ice-cutting Steam-boats.—Letters from Copenhagen of the 18th ult. state, that M. C. M. Hjorth has just resolved a problem which, for upwards of ten years, has vainly exercised the sagacity of naval engineers—and whose solution has more than once been proposed for competition, as well by the General Administration of Posts, as by the corporation of merchants in the capital. He has invented a steam-boat, capable of cutting its way through the thickest ice, with a speed nearly equal to that of its unimpeded navigation. The General Administration of Posts have received a most favourable report from a committee of ship-builders and machine-makers, to whom they had submitted the model, and have applied for authority to construct a vessel for the transport of the mail bags in winter.

HARPER'S PATENT RAILWAY CHAIRS.



Perspective view of improved chair.
C C, Cheeks of chair; W, Oak wedge upon which the rail rests; S S, Sleeper.

The annexed engravings represent the patent chair which has been introduced on one hundred yards of the South Western Railway, about half a mile below the Winchester station, in November 1839, since then the down trains have regularly passed over them.

The resident engineer, Edward Dixon, Esq., has favourably reported upon them several times down to the 28th of December 1840, the following are extracts from his reports.

"The principle is good in doing away with the use of spikes, and the enormous injury arising from the splitting of sleepers by boring and spiking. I have not paid sufficient attention to speak decidedly as to the difference of noise, but the result should certainly be favourable."

"I should like to see it laid on a large scale, as it has several advantages over the present method."

"I do not think any of the chairs laid down broke in the fixing, and none have broken since, I consider them less liable to breakage than the old chairs, there being no spikes to drive in, the risk is reduced, and in keeping the rail after the chair is fixed, there would be less chance of breakage from a miss-blow of the keying hammer striking the cheek of the chairs, on account of the wood which holds the chair in its place allowing of a little elasticity."

The Directors of the above Company have assented to an application made by Mr. Harper, and the engineer-in-chief Joseph Locke, Esq., has fixed for a further trial to be made on the Gosport Branch, near Winchester.

The saving of expense is stated by the patentee to be nearly 300*l.* a mile, exclusive of any estimate for advantages derived.

CHIMNEY POTS.

Sir—A correspondent, J. R. B., in your last number, as a remedy against the unsightly but unfortunately not altogether uselessness of chimney pots, (although never applied as they only ought to be), calls on builders to try the experiment of flues in the form of a tin coach horn, with the large end upwards. I am quite inclined to believe that such a trial would be successful, but if applied to the whole length of (say) a 40 feet flue, as I understand him to intend, any useful difference in its diameter would, I fear, so swell the stack, as, if conveniently practicable, would at once banish the beautiful shafts of the old English style, and lead, in too many instances, to no very sightly substitutes in that or any other style. What if the principle were applied to the last five or six feet merely; even then it might perhaps lead to deformities too frequently; this however is a secondary consideration, and the genuine architect can never be at a loss to get over such a difficulty, since it is his business to surmount difficulties, and therein prove his superiority to mere pretenders.

J. R. B. will perhaps favour us with his experience in, and valuable remarks on, the practicability of his suggestions.

I am, Sir, your obedient servant,

G. W. E.

February 16, 1841.

ENGINEERING WORKS OF THE ANCIENTS, No. 2.

Continuing our notes from Herodotus, the present paper will principally relate to the Egyptians, whose works like those of the Babylonians, have an interest for us, as giving rise also to a school on which Greek engineering was founded. It is one of the most ancient of which we possess authentic monuments and records. The Egyptians like the Babylonians principally devoted themselves to hydraulic engineering, in which they made great progress; their other works also afford convincing proofs of their attainments in other departments of the art. The account of Egypt in Herodotus might be almost termed a history of engineering in that country, where it was called into play as one of the great instruments of national advancement, the exploits of a prince consisting as much in the works he executed, as in the victories which he obtained. This is one of the features of a system of polity, to which Egypt was indebted for great social progress, and an exemptiom from many of the evils which afflicted surrounding nations. If from moral causes Egypt never attained the intellectual perfection of the Greeks, yet by the extent of its public works the country was brought into a high state of cultivation and productiveness, so as to make it for centuries the granary of Europe. It was less owing perhaps to the fertility of the soil, than to the facilities afforded as to internal communication, that the resources of Egypt were made so extensively available.

CAUSEWAY OF CHEOPS.

Cheops, it is said by our author, degenerated into extreme profligacy of conduct, and oppressing the Egyptians in every way, he proceeded to make them labour servilely for himself. Some he compelled to hew stones in the quarries of the Arabian (query) mountains, and drag them to the banks of the Nile; others were appointed to receive them in vessels and transport them to a mountain in Libya. For this service a hundred thousand men were employed, who were relieved every three months. Ten years were consumed in the hard labour of forming the road, through which these stones were to be drawn; a work cited by Herodotus as equal in difficulty to the pyramid itself. This causeway was five stadia in length, forty cubits wide, and its extreme height thirty-two cubits, the whole of polished marble, adorned with the figures of animals. So far our author, a modern account by Pococke and Norden, says that there is still a causeway running part of the way from the canal which passes about two miles north of the pyramids. This extends about a thousand yards in length, and twenty feet wide, built of hewn freestone. It is strengthened on either side with semicircular buttresses, about fourteen feet diameter, and thirty feet apart. There are sixty-one of these buttresses, beginning from the north. Sixty feet farther it turns to the west for a little way, then there is a bridge of about twelve arches, twenty feet wide, built on piers that are ten feet wide. Above one hundred yards farther there is another bridge, beyond which the causeway continues, about one hundred yards to the south, ending about a mile from the pyramids where the ground is higher. The reason for building this causeway and keeping it in repair seems to be the lowness of the country, the water lying on it a great while.

THE GREAT PYRAMID.—THE MIDDLE PYRAMID.—THIRD PYRAMID.

As we are rather giving common-place notes from the individual authors, than complete accounts of the works, we have less compunction in copying what Herodotus says of the much-written subject of the pyramids. Having described the causeway just mentioned, our author goes on to say that a considerable time was consumed in making the vaults of the hill on which the pyramids are erected. These he intended as a place of burial for himself, and were in an island which he formed by introducing the waters of the Nile. The pyramid itself was a work of twenty years: it is of a square form; every front is eight plethra long, and as many in height; the stones very skilfully cemented, and none of them of less dimensions than thirty feet. The ascent of the pyramid was regularly graduated by what some call steps and others altars. Having finished the first flight, they elevated the stones to the second by the aid of machines constructed of short pieces of wood (supposed by some to be the pulley); from the second, by a similar engine, they were raised to the third, and so on to the summit. Thus there were as many machines as there were regular divisions in the ascent of the pyramid, though in fact there might be only one, which being easily manageable, might be removed from one range of the building to another, as often as occasion made it necessary; both modes have been told me, says Herodotus, and I know not which best deserves credit. The summit of the pyramid was first of all finished off; descending hence, they regularly completed the whole. Upon the outside were inscribed in Egyptian characters, the various sums of money expended in the progress of the work for the radishes, onions and garlic consumed by the artificers.

The middle pyramid, attributed to the daughter of Cheops, is stated to have an elevation on each side of one hundred and fifty feet.

Chephren, the brother of Cheops, is mentioned as the builder of the third pyramid, which was less than his brother's. It has no subterraneous chambers, nor any channel for the admission of the Nile. The ascent is entirely of Ethiopian marble of divers colours, but it is not so high as the larger pyramid by forty feet. The pyramid stands on the same hill as that of Cheops, which hill is near one hundred feet high.

DOCKS.

Psammitichus, as a reward for services rendered in war, conferred on the Ionians and Carians certain lands, which were termed the Camp, immediately opposite to each other, and separated by the Nile. They were the first foreigners whom the Egyptians received among them; and "within my remembrance, in the places which they formerly occupied, the docks for ships, and vestiges of their buildings, might be seen," continues our author.

CANALS.—RED SEA.—SLUICE.—BOLBITINIAN.—BUCOLIC.—MEMPHIS.—AN ENGINEERING KING.—CIVIL ENGINEERS.—ENGINEERING THREE OR FOUR THOUSAND YEARS AGO.—SURVEYORS.

Pharaoh Necos, the son of Psammitichus, was, according to Herodotus, the prince who first commenced the celebrated canal leading to the Red Sea, which Darius, King of Persia, afterwards continued. The account of Herodotus is this:—The length of the canal is equal to a four days journey, and it is wide enough to admit two triremes abreast. The water enters it from the Nile, a little above the city Bubastis; it terminated in the Erythrean Sea, not far from Patumos, an Arabian town. They began to sink this canal in that part of Egypt, which is nearest Arabia. Contiguous to it is a mountain, which stretches towards Memphis, and contains quarries of stone. Commencing at the foot of this, it extends from west to east, through a considerable tract of country, and where a mountain opens to the south is discharged into the Arabian gulph. From the northern to the southern, or as it is generally called, the Erythrean Sea, the shortest passage is over Mount Cassius, which divides Egypt from Syria, whence to the Arabian gulph is exactly a thousand stadia. The way by the canal, on account of the different bends, is considerably longer. In the prosecution of this work under Necos, no less than one hundred and twenty thousand Egyptians perished. He at length desisted from his undertaking, being admonished by an oracle, that all his labour would turn to the advantage of a barbarian. Diodorus Siculus gives an account which brings the progress of the work down to the time of the Greek kings; he says:—The canal reaching from the Pelusian mouth of the Nile to the Arabian gulph and Red Sea was made by hands—Necos, the son of Psammitichus, was the first that attempted it, and after him Darius the Persian carried on the work somewhat farther, but left it at length unfinished; for he was informed by some, that in thus digging through the isthmus he would cause Egypt to be deluged, for they showed him that the Red Sea was higher than the land of Egypt. Afterwards Ptolemy, the Second finished the canal, and in the most proper place contrived a sluice for confining the water, which was opened when wanted to sail through, and was immediately closed again, the use of it answering this purpose extremely well. The river flowing through this canal is called the Ptolomean, from the name of its author. Where it discharges itself into the sea it has a city named Arsinöe. So far our authors; we may farther mention that the site of this canal, although it could not be found by Norden, was distinctly ascertained by the scientific commission attached to the French army, and that plans have been proposed by Mehemet Ali for restoring.

Of the seven mouths by which the Nile disgorges itself into the sea, two are stated to have been produced by art, the Bolbitinian and the Bucolic,* a circumstance that shows the importance which the Egyptians attached to ready access with the sea, as a means of promoting their maritime commerce. This, fostered as it was by the extent of inland navigation, was, whether in the hands of foreigners or natives, carried on upon a large scale, embracing not only domestic productions, but also the transit trade with India and the East, of which Egypt was so long the channel, and the value of which, as our subsequent observations will show, was appreciated at an early period. It is true that these two canals were also required for agricultural purposes, but we think we do not err in attributing also another motive. The order in which the seven branches of the Nile lie from

* Herodotus Euterpe.

east to west, which will show the position of the artificial branches, is thus; the Pelusian, the Mendesian, the Bucolic, the Sebennitic, the Saitic, the Bolbitine, and the Canopic.

One of the earliest hydraulic operations to which we find allusion made, was the recovery of the site of Memphis from the water by which it was overflowed. This is attributed to Menes, respecting the date of whose reign some diversity of opinion exists, Herodotus calling him the first sovereign of Egypt, while by Diodorus Siculus, he is styled the first king of Memphis, a view which is supported by many leading moderns. According to Herodotus the river before that time flowed entirely along the sandy mountain on the side of Libya, but by Menes its course was diverted. A hundred stadia from Memphis a bank was constructed, while a canal was led between the mountains, or according to some cut through them, to receive the stream. Of the ancient bed the site is still to be traced; Savary observes that it may be found west of the lakes of Natroun, extending for a considerable distance. Menes is also said to have sunk a lake to the north and west of Memphis, communicating with the river, which from the situation of the Nile, it was impossible to effect towards the east. On the spot thus rescued from the water was built the city of Memphis, by which Thebes was afterwards supplanted. We have here an instance at an early period of the diversion of a large river, and the recovery of a considerable space of ground, operations requiring a degree of skill in the plan, and energy in the execution which must give us a favourable idea of the engineer-king, who thus founded a city and a dynasty. It might at this place be a speculation whether it was not to the success of this work that Menes and his followers owed their kingdom and their authority, an hypothesis which if substantiated would be a unique addition to the claims of the profession. Cultivated as it has been by kings and warriors, it shares this honour with the law, with which the establishment of this new fact would give another step towards an equality of privileges—many owing their kingdoms to their legislation, and acquiring the exercise of authority by showing the necessity for it. Homer mentions the practice of medicine by powerful chiefs, but this art although it may have saved crowns, never seems to have gained them. We have however another subject of interest to the profession to lay before them—suggested also by the works of Menes. Our author informs us that even in his time, when Egypt was under the dominion of the Persians, the artificial channel was annually repaired, and regularly preserved; for he says had the river once broken its banks, the town of Memphis would have been greatly endangered. The necessity for the regular preservation of these works would undoubtedly require their being placed under the care of duly appointed officers, the exercise of whose functions being specially devoted to one object would lead to the formation of a particular class, essentially civil engineers. The same class of officers would also be required in other parts of the country, and thus we may conceive the organization at the distance of two milleniums and a half of a regular *water staat*. We have here a dawning of the system of a government corps of engineers, such as exists in most countries abroad at this moment, for there must have been in Egypt little opportunity for private practice when so much depended on the government. Private practitioners of engineering, although employed by governments, we shall perhaps hereafter find to have sprung up in Greece—so much split up in petty states, many of which would have no demand for permanent officers.

A princess, whom Herodotus calls Nitocris, is said by him to have floated to death a number of Egyptians. Having been appointed sovereign on the death of her brother, who had been murdered by the Egyptians, to be revenged on them she had a large subterranean apartment constructed, to which she invited a great number of those, whom she knew to be the principal instruments of her brother's death, and then by a private channel introduced the water of the river among them, and so destroyed them.

To Sesostris is attributed the execution of the general system of canals with which Egypt is provided, the number of which still existing is estimated by Savary at eighty, several of which are fifty, eighty, or a hundred miles long, and like rivers. On the return of Sesostris from his foreign conquests about three thousand two hundred years ago, he employed the captives of the different nations in collecting the immense stones which were employed in the temple of Vulcan. They were also, says our author, compelled to make the vast and numerous canals, with which Egypt is intersected. In consequence of their involuntary labours, continues the historian, Egypt which was before conveniently adapted to those who travelled on horseback or in carriages, became unfit for both; the canals occurring so often, and in so many winding directions, that to travel on horseback was disagreeable, but in carriages impossible. The inhabitants of the inland parts however benefited by obtaining a more regular supply of water for domestic and agricultural purposes.

In his next paragraph Herodotus informs us of the well known origin of surveying. Sesostris made a regular distribution of the lands, and assigned to each Egyptian a square piece of ground. Whoever was a sufferer by the inundation of the Nile, was permitted to make the king acquainted with his loss, and certain officers were appointed to inquire into the particulars, that no man might be taxed beyond his means. To this circumstance the historian assigns the origin of geometry, and from Egypt it was afterwards communicated to Greece. Here we have the origin of surveying, and of distinct officers engaged in its pursuit at a period according to received chronology, about 1350-60 years before Christ, now three thousand two hundred years, an antiquity, of which few professions are able to boast the equal, and one of the many circumstances in the history of civil engineering which show its early progress. Thebes was then the great school of Egyptian learning, and where geometry and surveying are supposed particularly to have flourished. It was perhaps to the government surveyors that the care of the canals of Memphis and other places was intrusted, so that then as it frequently is now, the surveyor might have been the probationer to the civil engineer. We do not apologize for troubling our readers with these observations, for we know that they like ourselves must feel the same interest in remembering that our's is no profession of to-day, but one which centuries ago, as now, was a powerful contributor to the progress of civilization, and the well being of the human race.

FOUR AND SIX-WHEELED ENGINES.

SIR—There is a subject connected with the question of four and six-wheeled engines as to their relative advantages when traversing curves, which has not, I believe, been sufficiently examined into; will you allow me, therefore, through the medium of your valuable journal, to call attention to it.

It has generally been assumed, because the distance between the fore and hind wheels is greater in six than in four-wheeled engines, that there must of necessity be greater danger of the former running off the rails when traversing curves.

If the engines moved with mathematical precision in the path laid out for them, this would undoubtedly be the case; but in consequence of the irregularities and inequalities of the rails, and the play which it is necessary to allow on this account between the wheels and the rails, the motion of the engine is varied from its true direction. Any person who has observed the action of a locomotive when passing rapidly along the rails, will have noticed that its track is not straight, but partakes of a serpentine movement, the fore wheels going from side to side in tolerably regular vibrations, and the greater the velocity the greater this effect, also the less the distance between the fore and hind wheels the greater this effect; for as the play is the same in all cases, the angle formed between the direction of the rails and the engine during these vibrations, will depend on the distance of the points of bearing; and it is probably in some measure attributable to this effect that four-wheeled engines have been found to go off the rails when travelling over straight parts, while such an accident was never, I believe, known to occur to a six-wheeled engine, unless from some foreign cause.

The distance between the centres of the wheels in the one case is about 7 feet, and in the other about 10 feet, and the play given to the wheels is half an inch. The greatest obliquity, therefore, that the six-wheeled engine can take up is ·5 of an inch in 10 feet, or 1 in 240, while in the four-wheeled engine it is ·5 of an inch in 7 feet, or 1 in 168. It would, perhaps, be too much to assume that the engine vibrated to the whole of this amount, but, to be quite on the safe side, we will take half of it, in which case the sine of the angle of obliquity between the direction of the engine and that of the rails will be expressed by $\frac{1}{480}$ in the six-wheeled engine, and $\frac{1}{336}$ in the four-wheeled engine, when travelling on the straight parts; and it will be seen that this apparently slight difference gives the advantage to the six-wheeled engine in all curves used in ordinary practice.

The sine of the angle at which an engine meets the rails on a curve supposing the engine to be moving mathematically true, will be $\frac{l}{2\,r}$, l being the distance between the centres of the fore and hind wheels, and r the radius of the curve in feet. The advantage in favour of the four-wheeled engine in this respect, on curves of the same radius, would therefore be as $\frac{7}{2\,r}$ to $\frac{10}{2\,r}$; but to this must be added in practice the angle of obliquity due to the vibratory motion of the engine;

hence, when both engines are in their most disadvantageous positions on a curve, the sines of the angles they form with the rails will be nearly as $\frac{7}{2r} + \frac{1}{336}$ to $\frac{10}{2r} + \frac{1}{480}$, and when these angles are equal to each other, we have $2r + \frac{1}{336} = \frac{10}{2r} + \frac{1}{480}$, or $r = \frac{161280 \times 3}{288} = 1680$ feet $= 560$ yards. That is to say, that supposing the deviation from the true position of the engine, due to the play between the wheels and the rails to be no more than a quarter of an inch in its length, the six-wheeled engine meets the rails at a more favourable angle, and is consequently less likely to run off them on all curves in which the radius exceeds 560 yards; on curves of a less radius the four-wheeled engine begins to have the advantage.

I am, Sir,
Your obedient servant,
W. H. Barlow.

Brereton,
Feb. 6th, 1841.

IMPROVEMENT ON ECCENTRIC RODS.

Sir—Among the numerous readers of your highly esteemed Journal perhaps there are many to whom the subject of this communication will appear of little importance, I therefore apologize for once more imposing it upon your pages.

In your present month's number (page 66,) I observe a communication signed H. E., in which your correspondent points out several inconvenient conditions as inseparable from the system of two eccentrics, in reply to which, with your permission, I beg to make the following remarks. I will notice these conditions one by one after the same order H. E. has pointed them out.

First. I do not clearly see how it is possible to give the lead *at all* either with or without a complication of levers unless the eccentric precedes the crank in its *action*. Even supposing the working the valve, when going forward, by the upper pin of the double lever to be inseparable from the system, it has in my opinion a peculiar advantage, in this respect, over the four eccentrics, the rods of which are kept in gear partly by their own weight, for instance. Suppose some derangement to take place in the reversing apparatus of an engine fitted with with the four eccentrics; the two suspended eccentric rods would fall upon the lever studs of the valve motion, and very probably cause a most serious crash. Now with the double ended eccentric rods the case would be rather different; their falling from the upper to the lower studs of the double levers would only reverse the action of steam upon the pistons, and as the engine-man has always the power to shut off the steam, he could *instantly* prevent the reverse motion of the engine.

Second. The centre of the double lever shaft may be situated above or below the line C, E, just as circumstances may require, but it is requisite to fix the eccentric so that it shall be exactly perpendicular to the centre of the shaft and crank axle, when the piston is at either end of the cylinder. I do not see any just reason why this should be considered as an inconvenience.

Third. I beg to state the amount of lead is *not* dependant upon the length of the eccentric rod, as H. E. has stated, but it depends upon the angle at which this rod works with the centre of the lever shaft and crank axle.

Fourth. It is possible to construct the valve motion so as to give the power of increasing or decreasing the amount of lead both ways, but as this would cause an additional number of parts, and consequently render the system more complex, I will admit of "the lead being determined must remain invariable."

With the four eccentrics, providing they are all independent of each other, that is, fixed on the shaft separately, you certainly have the advantage of varying the amount of lead; but the eccentrics are not always *independent* of each other, they are very frequently *cast all together*. In this latter case the lead, for both ways, is determined in the eccentrics, and of course remains *fixed*, therefore, you cannot increase it one way without diminishing it the other, this H. E. has pointed out to be the *most serious objection* to the two immoveable eccentrics. With the four independent eccentrics the lead may be varied correctly both ways it is true, still this is a rather particular point, and requires considerable time to effect the alteration accurately, consequently, I am informed, is very seldom resorted to. I have hitherto been totally unaware of what H. E. has stated in his eighth paragraph.

Another correspondent (An Apprentice in Glasgow,) remarks that "I have described the contrivance for working an engine with one eccentric as an invention of my own, although it has long been quite common in that country." I certainly have described it as my own, and I had every possible reason for doing so. I was not aware that it had ever been applied *successfully*, that is, exactly *correct in every point*. But I am aware, and well aware too, that engines, for winding purposes, have long been common in mining districts with one immoveable eccentric, and a double lever for reversing; and I have been informed that this contrivance has frequently been applied to engines for marine purposes, but in *both cases* has failed in point of correctness. This has been the consequence of not fixing the eccentric rods at the *proper angle*, &c.

Notwithstanding all that H. E. has said, he, together with the Apprentice, appears to be in favour of the two immoveable eccentrics.

I remain, Sir, your's, very respectfully,
J. C. Pearce.

Leeds, Feb. 8, 1841.

ON THE CONSTRUCTION OF IRON BRIDGES.

When we consider the superiority of iron bridges, says M. Polonceau, in his notice of the new plan of iron bridges invented by himself, and of which the bridge of Erdre (at Nantes) affords a good specimen, we are astonished that so few have been constructed in France, and even in England, where it is so much the custom to make use of iron, and where it is so plentiful. If these bridges are compared with stone bridges, it will be found that they are constructed with much less difficulty, and that they are considerably less expensive, and that when they have cast-iron roadways they are not inferior, if not superior, to them in durability. In fact, cast-iron is more durable and more strong than stone; it is better adapted to bridges with large arches, because the weight of an arch in iron being much less than that of an arch in stone of the same span, the destruction of the piles and abutments is less to be apprehended, and on this account can be constructed at less expense.

Compared with wooden bridges, bridges of cast iron cost about a half less than bridges of that kind which have abutments in stone; but their duration is indefinite, and the keeping wooden bridges in repair is attended with great expense, while the cost of repairing iron bridges is a mere trifle. The difference of expense between solid iron bridges and that of well executed suspension bridges is not so considerable as might be supposed.

In endeavouring to explain the causes which have prevented these kind of bridges from being more generally used, continues M. Polonceau, we discover three principal ones which have been unfavourable to their general adoption.

First—The great expense of iron, and the uncertainty in the casting of the larger pieces, before the year 1830.

Second—The great expense of the only two iron bridges constructed in France before that time. The cost of the *Pont des Arts* amounted to 900,000f., and that of Austerlitz to two millions and a half, not including the approaches.

Third—The accidents and repairs required by these two bridges.

Those works of art were constructed on two entirely opposite principles. In the bridge of Austerlitz the arches, and the triangular pieces above them which support the roadway, are composed of portions of the arcs in frame-work, and are attended with all the inconveniences consequent on this plan; and further, these frame-work pieces are small, much ornamented, and are of unequal thickness, and to this may partly be attributed the accidents which take place.

The plan of construction adopted in the *Pont des Arts*, which is composed of large arches connected together by pieces of iron, is more rational; but the principal arches are not sufficiently strong, and owing to the variations in the thickness of the castings, the metal contracts and expands unequally. In each of these bridges durability has been sacrificed to lightness and elegance, which occasions frequent fractures in the least durable parts.

Southwark Bridge, in London, one of the most remarkable of the kind, is composed of portions of arches, like the bridge of Austerlitz, but those are plain, and are not carved, although they are more than two metres high, and the method on which they are arranged is much superior to that adopted in the bridge of Austerlitz. The strength and entire preservation of the Southwark bridge is to be attributed entirely to the great quantity of iron used, which was procured at enormous expense, and amounted to more than fifteen millions of francs. It is probable that the great expense of this beautiful structure has prevented its being imitated.

The natural consequence of what has been stated is, that it is

impossible to erect any more iron bridges in France, unless a new plan could be adopted of constructing them on more durable principles than those kind of bridges have ever been constructed, and at less expense than the English bridges. This double problem M. Polonceau has solved, by constructing, on an entirely new system of his own invention, the Carrousel bridge at Paris.* It is on this plan of making bridges, now well known by the name of Polonceau bridges, that the bridge of Erdre is also constructed.—*Echo du Monde Savant.*

RAILWAY SIGNALS AND REGULATIONS.

We last month gave a copy of the resolutions passed at the railway conference at Birmingham; since then a full account of their proceedings has been published, with the code of signals and regulations proposed to be adopted on all railways throughout the United Kingdom, a copy of which we give in full.

RULES AND REGULATIONS, PROPOSED TO BE OBSERVED BY ENGINEMEN, GUARDS, POLICEMEN, AND OTHERS, ON ALL RAILWAYS.

Orders to Enginemen and Firemen.

I.—No locomotive steam engine, except in case of some extraordinary necessity, shall pass along the wrong line of road—that is to say, on the right hand line as it moves forward—but shall, in all cases, observe the same rule of the way as on the turnpike roads, by proceeding along the left-hand line. And every engineman and fireman shall keep a good look-out all the time the engine is in motion. And no person, except the proper engineman and fireman, shall be allowed to ride on any locomotive steam engine or tender without the special licence of the directors, or of the engineer or manager of the railway.

II.—In case of accident, if any engine shall be unavoidably obliged to pass on the wrong line of road, the engineman shall always send his assistant, or some other person, back beyond the nearest stopping place or shunt, before the engine moves backward, to warn any engine coming in the opposite direction; and if dark, the man who goes back in advance of a returning engine shall take a light, and make a signal, by waving the same UP and DOWN to any coming engine to stop; and the engineman of the engine moving on the wrong line shall make constant use of the steam-whistle, and must not move in the wrong direction further than to the nearest shunt, and being arrived there, shall proceed instantly to remove the engine off the wrong line of road.

III.—All engines travelling in the same direction, shall keep half a mile at least apart from each other; that is to say, the engine which follows shall not approach within half a mile of the engine which goes before.

IV.—No engineman shall, at any time or under any circumstances, leave his engine or train, or any part of his train, on the line of way, without placing a man in charge of the same, to cause the proper signals to be made to prevent other engines from running against them.

V.—Enginemen having charge of goods or luggage trains shall always exert themselves to keep out of the way of coach trains, by shunting, if necessary; and, if doubtful of getting out of the way of a coach-train, shall direct gatemen and plate-layers to make signal to coach trains that a luggage train is before them.

VI.—No engine, carriage, or wagon, or train of carriages or wagons, whether loaded or unloaded, shall (except only in case of absolute necessity, to prevent accident or collision) stop upon the line of any highway, so as to interrupt the passing along such highway or public road, whether the same be at or near to any of the stopping places on the railway or not.

VII.—No engine shall be allowed to propel before it a train of carriages or wagons, but shall in all cases draw the same after it, except when assisting up an inclined plane, or in case of any engine being disabled on the road, when the succeeding engine may propel the train *slowly* as far as the next shunt, or turn-out, at which place the said propelling engine shall take the lead.

VIII.—In the event of the road being obscured by steam or smoke, (owing to a burst tube, or from any other cause,) any engine for train coming up shall not immediately pass through the steam or smoke, but the engineman shall stop at a sufficient distance to prevent a collision, and shall ascertain that the way is clear and safe before attempting to proceed.

IX.—If a coach train be stopping to take up or set down passengers, on the road, or for any other cause, luggage trains are not allowed to pass it, while so stopping, on the opposite line; and if the engineman of a *coach train* sees another coach train stopping on the road, he must slacken speed as he approaches it, and blow his whistle, to give notice to passengers belonging to the stopping train, that another train is about to pass them.

X.—In going down any inclined plane, every engineman having charge of a luggage train, shall take care that he has full and competent control over the speed of his train, by pinning down, or causing to be pinned down, his wagon breaks, fewer or more, according to the size or weight of the train, whether there be a luggage breaksman with the train or not. And in case of accident for want of this proper control over the speed, the engineman shall be held responsible. And the policemen at the top of the inclines shall, and are hereby charged to, assist in pinning down the breaks, when desired so to do by the engineman of the train.

Rules to be observed during a Fog, or in Thick Weather.

XI.—Whenever a coach train stops at any of the stations or places for taking up or setting down passengers, (during a fog, or in thick weather), the gateman or policeman of the station shall immediately run 400 yards behind the train, or so far as may be necessary to warn any coming engine, in order to prevent its running against the other; and all enginemen shall slacken speed in foggy weather, and proceed at a slow pace at an ample distance from, and as they approach, each of the stations and stopping places, in order that they may have the complete control of and be able to stop their engines and trains without risk of running against any train which may happen to be waiting at such station or stopping place. And in case any engine (whether with coaches or luggage waggons, or without) shall stop in foggy or thick weather in any part of the road where there shall be no plate-layer to render assistance, the fireman shall immediately run back 400 yards, or so far as may be necessary, to warn and stop any other engine coming in the same direction.

In foggy weather, enginemen are cautioned to make frequent use of their steam-whistle when they approach any station; also, whenever they are obliged to stop on the road, or when, from any cause, they are obliged to go slower than usual, in order to prevent accidents from trains which may be following on the same line.

Order to Gatemen and Policemen.

XII.—All policemen and gatemen are required, when a luggage train approaches their several stations, and before she comes up, to go on the line and inspect both sides of the train, to ascertain whether any of the loading (particularly bags of cotton or wool) have slipped so as to *overhang* the waggon more than when first loaded; and if such be the case, to make immediate signal for the *train to stop*, in order that the loading may be put right and fastened on again before the train proceeds.

N.B.—All enginemen, firemen, guards, policemen, gatemen and others to whom the foregoing rules may apply, are held responsible for their strict execution and observance; and they shall report to the directors, or to their immediate superintendent, any servant of the Company who shall refuse or neglect to comply with the regulations hereby ordered to be observed.

CODE OF SIGNALS RECOMMENDED TO BE OBSERVED ON ALL RAILWAYS.

By Night.—The *white* light, stationary, indicates that all is right, but if waved *up* and *down*, is a signal to stop; if waved *to* and *fro*, sideways, to proceed cautiously.

The *red* light, stationary, is a signal *always to stop*; if on a moving train, it is a caution to all following trains to keep the required distance.

By Day.—The *red* flag, or ball disc, is the signal always to stop.

The *blue* flag, or ball, is to stop second class coach trains or luggage trains, for the purposes of traffic.

The *black* flag is used by plate-layers, to indicate that the road is undergoing repair, and that trains must pass slowly.

It is to be understood, that any flag, or hat, or lamp, of whatever colour, waved up or down, is a signal to *stop*.

Regulations as to Signals.—1. Every train on the railway shall show a red bull's eye, or reflector lamp, on the last carriage or wagon; and the guards of the coach trains, the breaksman of the luggage trains, and the engineman of an empty engine, or, with a wagon train without a breaksman, shall see to and be held responsible for, the execution of this order; and if a coach, or truck, or horse-box, or wagon, be attached to or detached from a train on any part of the road, the guard, or breaksman, or engineman shall immediately change and replace the red bull's eye, or reflector lamp, so that the same may still be in the *rear* of the last carriage or wagon in the train, showing backward.

2.—Every engine tender must carry a lamp, so fixed as to admit of being turned round, exhibiting a *white* light forward, and a *red* light backward, in whichever direction the engine may be moving.

3.—Every gateman or policeman shall light his gate or station lamp at dusk, and shall have his hand lamp constantly trimmed and burning, and ready to give such signals as may be required.

4. If a coming engine or train be required to stop to take up passengers, a *blue* light must be shown in the gate-lamp; otherwise the common *white* light.

5.—If a train approaches when a previous train has passed through, only a few minutes before, the gateman shall signify this circumstance to the engineman by the waving of his hand-lamp *to* and *fro*, sideways, which means that caution is required; on which signal all enginemen are required to go slowly and keep a good look-out.

6.—But if a gateman, owing to some accident, or any extraordinary cause, wish to stop an engine which is approaching, he must show his *red* light, and must also wave his hand-lamp *up* and *down*, up to the height of his head, and then down to the ground, till the engine comes up; and all enginemen are required to stop at either of these signals being given; and a gateman must make this signal to an approaching engine, if a previous engine has passed through this gate only one or two minutes before.

* See drawings and description of this Bridge in the Journal, Vol. II. page 79.

N.B.—The *red* flag, or ball, must be used in the day, in the same manner as the *red* lamp by night.

Rockets or *blue* lights are extraordinary signals, and when an engineman sees them he must immediately stop to ascertain their cause.

Engine Whistle.—7. When *one long whistle* is given, it is a signal to gate keepers, policemen, and others in front, that an engine is coming, and this signal is to be used on approaching public roads, during a fog, or when a first class train approaches a station where a second class train is stopping, and generally as a caution when required, for persons on the line to keep out of the way.

But when an engineman wishes to make signal to the guards, or breaksmen *on the train*, that they are to put on their breaks and stop, he must give a *quick succession of whistles*, making an interrupted, tremulous, or vibrating sound; and all guards or breaksmen, whether with coach or luggage trains, hearing this signal, *must immediately* hold hard on the break or breaks under their charge, so as to stop the train *as quickly as possible*.

NEW INVENTIONS AND IMPROVEMENTS.

IMPROVEMENTS IN STEAM ENGINES.

Thomas William Parkins and Elisha Wylde, of Portland-street, Liverpool, Engineers, for an improved method of making and working locomotive and other steam engines. Enrolment-office, Jan. 12, 1841.

This improved method relates to the slide valve and throttle valves of steam engines, and consists in a novel mode of constructing them, so as to facilitate the action of the valves, to place them under more perfect control, and to afford a freer entrance to the steam cylinder under certain circumstances.

The first arrangement is for working the slide valve without the use of eccentrics, in order that it may open almost instantaneously at the time the engine is passing the centre. For this purpose a lever is fixed upon the cross-head working in a link connected to a second lever fixed on a shaft or weigh-bar across the engine, whereby a rocking motion is produced. On the other end of the weigh-bar a double lever is fixed, carrying two studs above and below the centre of the said shaft or weigh-bar, for the forked rod to work upon. One end of this rod is attached by a working joint to a fourth lever fixed on the weigh-bar, which gives motion to the slide valve at each succeeding return of the cross-head to the extremity of its stroke. The levers are so arranged that the slide valve is always kept wide open at the period of the engine passing the centre, instead of being shut, as is always the case when an eccentric is used, and by which means the full effect of the steam is employed up to the last moment.

Secondly, a new method of constructing the slide valve, being an improvement upon the old D slide valve, is described; the object being to get rid of almost the whole of the immense steam pressure which always presses upon slide valves of the present construction, and at the same time to give a free passage for the escape of the waste steam throughout the whole of the stroke. This slide valve consists of a hollow square ring of metal, working between two surface plates, the lower one being the side of the cylinder, the upper one provided with set screws or other suitable means of adjustment. The hollow ring beds upon the cylinder, and is furnished with a square metallic packing upon its upper surface, which, abutting against the adjusting plate, makes the slide valve perfectly steam tight. The slide valve is made long enough for the eduction passage to remain open while the steam way is closed, and *vice versa*.

Thirdly, the patentee describes a peculiar mode of constructing the regulator or throttle valve of steam engines, especially as applied to locomotive engines, so as to afford a ready and convenient means of admitting steam to either one of the cylinders only, or to both of the cylinders at the same time. The regulator or steam passage is in this case a flat surface, with passages through it at the distance of one end of the cylinder from the other, and so disposed that when the regulator's handle is inclined to the starboard, steam is admitted into the cylinder on the larboard side of the engine; on inclining the handle over to the larboard, the steam is also admitted to the starboard cylinder, but on placing the regulator handle in a vertical position, the throttle valve is closed, and the steam communication cut off from both cylinders.

A fourth improvement consists in certain additions to the machinery for working the slide valve, so as to cause the steam to work in the cylinder expansively, in order to economise fuel; for this purpose two slots are made in the top of the link in which the cross-head works, in which two bell-crank levers work on pivots; to the under side of the engine framing, a roller is fixed between the two levers, being a fulcrum to act against when they are alternately pressed down by the roller (attached to the lever on the cross-head), which works in the link passing over them; this causes the link to advance sufficiently to close the slide valve, or, in other words, to shut off the steam at the determined portion of the stroke.

Finally, an arrangement is exhibited for reversing the direction of the steam, so as to stop the engine and drag the wheels whenever circumstances render such a procedure necessary. In order to accomplish this movement, a handle is placed on one side of the foot plate, which is connected to a bell-crank lever, connected by a link to the tappet-rod. This handle is to be secured by a spring guard, and when in a vertical position the tappet-rod will be entirely out of gear; when it inclines forward, it will be in gear for going either forward or backward; and when it inclines backward, the tappet-rod will be lifted on to a stud on the third lever above the centre of the shaft connected with the link on the other side, which will stop the motion of the engine almost immediately, as the steam will be admitted into the cylinder before instead of behind the piston, which will drag the wheels and bring up the engine.

The claim is to 1. The construction of the slide valve, being a hollow ring through which the steam is either admitted or exhausted, and the means used for keeping the said slide valve steam tight.

2. The combination of the machinery for moving the valve, especially the construction of machinery for moving the said valve so as to work the steam expansively.

3. The construction of the regulator or throttle valve by which steam is admitted to either cylinder only, or to both cylinders at the same time.

4. The construction of machinery for moving the slide valve so as to cause the steam to enter the cylinder before instead of behind, and make it act against the piston.—*Mechanics' Magazine.*

TOOLS FOR BORING.

William Ash, of Sheffield, Manufacturer, for improvements in augers and tools for boring. Petty Bag Office, Dec. 24, 1840.

These improvements consist in the combination of cutters and guides with a shank or spindle. The cutters are rectangular pieces of steel somewhat resembling the cutting side of a centre-bit. The guides are helical pieces on the outside, of various sizes, the interior of which fits the shank or spindle. The spindle has a pointed screw at the end, the size of the thread varying according to the kind of wood to be operated upon; at some distance up, on the side of the spindle, there is a circular stop, there is also a square opening just above the worm, passing through the spindle. The helical guide, of the size required, is first put on the spindle, and a cutter inserted in the square aperture below it, where it is firmly fixed by driving in a wedge. If a larger or smaller hole is required, the wedge is struck out, when the cutter, &c. may be easily removed, and replaced with guides and cutters of the size required. Another form of guide is shown, consisting of a circular plate of metal, with a thimble in its centre, supported by two cross pieces from the outer edge. The first, or helical guide, however, is preferred, from its being longer, and also from its affording a channel for the ready escape of the chips, thereby clearing the hole as the cutter advances.

The claim is for the application of moveable cutters and guides to a shank or spindle, as described.—*Ibid.*

MACHINERY FOR CUTTING AND WORKING WOOD.

William Hickling Bennett, of Wharton-street, Bagnigge Wells Road, Gentleman, for improved machinery for cutting and working wood, Enrolment-office, Dec. 24, 1840.

The improvements comprehended in this patent are—Firstly, a new system of guides for boards while passing through the wood-cutting machines. The iron frame of the guides varies in shape in different machines; it forms a bed on which the guides traverse. The guides are formed of puppet-heads in pairs, one being fixed, the other moveable in order to hold and guide wood of different sizes. Moveable pieces slide over the inner vertical faces of the guides, and pressing down upon the upper surface of the wood it is thus held firm and steady.

Secondly, an improved mode of elevating and depressing the upper pair of rollers, when the wood is carried forward by their means. The axes of the upper rollers turn in blocks which slide up and down in grooves in the upright side frames of the machine. They are regulated by spur and bevel wheels, in conjunction with spiral springs, so that while the wood is firmly held, an elasticity is obtained by means of the springs, which allows any irregularities in the surface of wood to pass through the rollers.

Thirdly, an improved mode of admitting oil to the working parts, viz., the circular saws, shafts, spindles, &c., consisting of a cup with a tube at the bottom furnished with a stop cock, to be so adjusted as to allow any number of drops per minute to fall from the nipple into the channel leading to the bearings requiring lubrication.

Fourthly, an improved mode of sawing and dividing wood, so as to effect the planing at the same time; the arrangement being also applicable to veneer saws.

For this purpose, there are slots near the periphery of the circular saws, approaching as near to the edge as is consistent with due strength; in these slots side cutters are fixed, with their edges ground and set to the same angle as a plane iron. These cutters project slightly beyond the set of teeth of the saw; so that a shaving is continually taken off as the saw revolves. Or the edges of such slots in the saw plate may be turned up and used in lieu of detached cutters.

Fifthly, the application of the foregoing construction with two or more sets of circular cutters, so as to form two or more strips of plain or ornamental moulding. To accomplish this, two or more circular saws are mounted on one spindle between which, instead of washers, blocks are fixed, holding the cutters in the upper edges. These are circular and may be either plain or moulded, and they project sufficiently to perform the necessary operation as rapidly as the circular saws can rip the scantlings or boards into strips.

Sixthly, an improved mode of forming moulding and other cutters. These cutters may be of any required shape, and are attached to blocks, fixed on